THE

MINING MAGAZINE:

DEVOTED TO pp 187-192 wanting

Mines, Mining Operations, Metallurgy, &c., &c.

EDITED AND CONDUCTED BY

WILLIAM J. TENNEY,

AIDED BY

STEPHEN P. LEEDS.

VOLUME FOUR.

FROM JANUARY TO JUNE, 1855.

New York:
PUBLISHED AT 98 BROADWAY.
John F. Trow, Printer, 53 Ann Street.
c 1855.

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VOL. IV.—JAN. & FEB., 1855.—Nos. I. & II.

Art. I.—THE VENTILATION OF MINES AND COLLIERIES.*— By John Phillips, F. R. S.

ACCIDENTS.

The great majority of the collieries in the districts of the Tyne, Wear, and Tees, may be confidently pronounced to be now safe for men to work in, with candles in the whole mine, with lamps in the broken, *under ordinary circumstances;* but there are several which require to be worked exclusively by lamps, though ventilated by strong currents of air; and hardly any can be pronounced positively free from the danger which accompanies *unexpected eruptions* of fire-damp or choke-damp. For it may happen, in the best ventilated colliery, that the supply of air is insufficient at the moment to dilute the inrushing gas; and even when, in fiery mines, the further precaution of excluding naked lights is added, there remains the possibility of one being out of order, or rashly, injudiciously, or wickedly employed. By no conceivable combination of skill and diligence can every avenue to accident be always completely closed.

Yet we may freely assert, that for all ordinary circumstances, constant vigilance, aided by well-supplied air currents and the Davy lamp, is enough to insure safety in any colliery of the district; and that even for extraordinary issues of fire-damp, the same means leave but very short intervals of time, and very limited spaces of working, in which the mine can ever be regarded as insecure. If, during these short periods, the dangerous element is met by skilful combinations, and the calm promptitude which, in such moments, belongs only to instructed minds, its power melts away, and the men are saved. But if, where the spell of the lamp would be only just sufficient to keep down the rising fire, the naked candle should be burning, if the lamp be found unscrewed, or with one wire broken or displaced, the result need not be told. It is written in that list of fatal explosions by which the attention of the Legislature has been so often roused.

* Continued from page 386, vol 3, No. 4.

According to a list, the number of accidents by explosion has been increasing in the districts of Northumberland and Durham since the commencement, or, more accurately, since the middle of the eighteenth century. If we class the numbers for each successive 10 years, commencing with 1756, the following regularly augmenting series is obtained:—

	Explosions.	Deaths.
From 1756 to 1765, inclusive	5	34
1766 to 1775, "	6	101
1776 to 1785, "	9	41
1786 to 1795, "	12	105
1796 to 1805, "	12	151
1806 to 1815, "	17	302
	61	734
(Davy lamp introduced.)		
1816 to 1825, inclusive	20	296
1826 to 1835, "	23	344
(Parliamentary inquiry.)		
1836 to 1845, inclusive	15	328
1846 to 1849, "	1	31
	59	999

The maximum number is found in the period from 1826 to 1835; viz., 23 explosions in 10 years, with a loss of life amounting to 344 persons, or above 34 in a year. The year in which the greatest number of explosions happened is 1817; viz., 6 explosions, deaths 77. The year in which the greatest number of deaths by explosion occurred, is 1812; viz., 116 deaths; in 1835, 113 deaths; in 1844, 103.

This is, in several respects, a discouraging statement. For the course of nearly a century, the progress of these calamitous accidents has, apparently, been opposed in vain. Very superior powers of ventilation, and better systems of employing the air, have come into use; the Davy lamp has become as familiar to the miner as his pick or shovel; and evidence has been tendered to Parliament conclusive as to the knowledge and humanity of many among the owners and managers of collieries. But since the epoch of Davy's admirable invention—supported by vastly improved ventilation—more lives have been lost by explosion than in an equal period before these improvements began.

It is however certain, that without such improved ventilation, and without the lamp, more lives by far must have been lost: it is, in fact, to the great augmented difficulties which attend deeper and more extended underground works, and to the insufficient use of the means of safety now actually possessed, that we must ascribe the comparatively small success which has attended the efforts to lessen the frequency and fatality of explosions.

Accidents by explosion are usually ascribed to deficiency of

the ventilation, insecurity of the Davy lamp, ignorance or negligence of the managers, ignorance or rashness of the men. The following remarks will show, 1st, how necessary it is to avoid judgment on this subject before careful investigation; and, 2d, how completely erroneous is the opinion that further improvement is hopeless.

1. The state of ventilation in the worst of the deep northern collieries, is probably much better now than it was at the time when Mr. Buddle gave evidence to Parliament (1835). He describes his standard air courses as varying from 2,000 to 3,000 cubic feet per minute, and the most powerful he had occasion to employ as about 3,800 feet in a minute (Evidence, No. 1988). And again (2,081), "I am quite certain that the quantity of air put down into these (Wallsend) pits would not be less than 5,000 feet of air put down in a minute." Now at this day it is a very common thing to pass 8,000 cubic feet of air in a minute along a pair of exploring drifts, and to carry 10,000 cubic feet of air into one small working district; and Wallsend Colliery receives, instead of 5,000 feet, not less than 120,000 feet in a minute.

2. The state of ventilation in the northern collieries is still improving. The records of the quantities of air measured at successive times in particular collieries, will prove this encouraging fact in two collieries remarkable for good ventilation.

QUANTITIES OF AIR AT SUCCESSIVE TIMES.

		Cubic Feet per Minute.	
Haswell Colliery,	1839, Nov.	65,648	From Mr. John Taylor.
	1844, Oct.	88,628	"
	1847, Apr.	91,280	"
	1849, Apr.	94,900	"
	Aug.	100,917	"
Hetton, exclusive of Elemore Pit—			
	1835, Dec.	96,800	From a paper by Mr. J. Robson.
	1849, Aug.	168,000	From Mr. N. Wood.
	1850, Jan.	190,000	"

The effect of this improved ventilation is sensible in the usual practical test—the state of the returns. Mr. Buddle speaks of the excellent daily practice of reporting the condition of the return air which prevailed in his time, and the same is still continued. Those reports were often (should always be) written down daily in the office; and they demonstrate that in many mines, for months together, the returns are scarcely in any degree thickened; very rarely so fouled as to suggest the least anxiety about their going straight to the furnace. Bad ventilation is becoming rare and exceptional, and may, by easy means,—by fair comparison with neighboring collieries,—by scientific and practical experiments before intelligent witnesses,—by judicious private sugges-

tions,—by privately or publicly expressed opinion, be entirely shamed out of the district.

I have summed together the quantities of air which circulate through the following eight collieries, and compared this with the number of acres which are ventilated, the result being 742,798 cubic feet in one minute, for 3,823 acres ventilated; the average being 196 cubic feet of air per minute, to one acre of ground. I have also compared the quantity of air circulating in seven of these collieries, with the number of men (hewers) employed; and find for every man, upon the average, 562 cubic feet of air in one minute. The collieries, are Hetton, Wallsend, Haswell, Murton and South Hetton, Willington, Walker, Castle Eden, and Wingate Grange. I could greatly multiply observations and results of this kind, but there are reasons against giving data of this kind in detail without abundant explanations.

The invention of the lamp, it must always be remembered, has caused the re-opening of collieries, such as Walker and Wallsend, which had been worked in the whole, and left standing in pillar. The lamp has conducted exploring drifts and extensive works through the most fiery districts in the most treacherous seams. Greater dangers (or rather a great amount of dangers) have certainly been encountered since the lamp was first introduced on the Tyne; and if it can be shown that the confidence which it inspired was misplaced,—if it has allured to perils against which it, in reality, gave no protection,—then melancholy indeed is the prospect before us. For the average depth of collieries is steadily augmenting, and with augmented depth many of the elements of danger to the miner increase.

But has the safety-lamp really disappointed the expectations of science and betrayed the confidence placed in it for 30 years, in hundreds of collieries, by thousands of miners?

How many of the 59 explosions which are chronicled during the employment of the lamp have been caused by it? How often have lesser cases of burnings been charged by the sufferers on the communication of flame through the gauze? How often have viewers, overmen, wastemen or miners, inflamed the gas of the innumerable small blowers in which they have plunged the lamp?

The answers to these questions may surprise those who lightly esteem the result of Davy's researches on flame. It is certainly not proved, perhaps not capable of proof, that any one of the great explosions which have happened since 1815, has been caused by the uninjured lamp; and instead of the flame passing easily through the gauze, there is evidence of strong efforts made to blow out the internal flame of gas, without causing it to ignite the surrounding inflammable air.

Mr. T. J. Taylor has bestowed much attention on the history of explosions, and with a view to judge of the degree of security really afforded by the lamp, he has classed all the heavy explo-

sions of the last 20 years, which have happened in the northern district, in the following table:—

Collieries.	Number Killed.	By what means Gas ignited.
Washington	14	By naked lights.
Jarrow	42	" " "
Springwell	47	" " "
Wallsend	102	" " "
Burdon Main . . .	11	" " "
Hetton Down's Pit . .	22	" " "
Springwell	30	" " "
Wallsend	11	" " "
South Shields . . .	51	" " "
Willington	32	" " "
Thornley	9	" " "
Wreckington . . .	28	" " "
Haswell	95	A doubtful case; after full investigation, I believe by a naked light.
Jarrow	39	By a naked light.
Hebburn	31	" " "

In 13 out of the 14, the explosions have occurred in the whole mine where candles are used; that is, in the districts where pillar-working had not commenced, and, consequently, no lamps were used. Upon these data, then, no explosion whatever can be shown, and scarcely one can even be suspected, to have happened in consequence of the inadequacy of the lamp.

The experience of many years has shown the Davy lamp to be practically safe in collieries, which, before its introduction, had been the theatre of sad explosions. When Walker Colliery was re-opened in 1817, the exclusive use of the lamp was instituted, and it is still continued. In the course of more than 30 years it has been subjected (Mr. Clark informs me) to very severe tests, when it has always proved safe. Since the Jarrow accident in 1845, the lamp has been exclusively used in that colliery. It is exclusively used in Wallsend, Willington, and Felling, and in all these cases it appears to be fully deserving of the confidence thus placed in it. It would be mere presumption for me to add my feeble testimony to this conclusive evidence; but it seems to me that much of the ingenuity which has been exercised in demonstrating the possibility of causing the Davy to explode particular gases around it in the laboratory, might have been turned to better purpose, if employed on a faithful study of the lamp as it is in daily use in the whole mine, the broken mine, and the returns of a colliery.

If, then, ventilation be improved since 1815, and be still improving, and the Davy lamp really affords a high degree of protection, we can only ascribe to increased physical difficulties, and to inadequate methods and unsafe practices in mining, the occurrence of accidents by explosion.

The physical difficulties to be overcome in modern collieries are really greater in the earlier workings. Augmented depth, increased area, and greater activity of working are all productive of increased and increasing danger. The gas is found of higher tension, more completely shut in, possessed of greater explosive power, in deep than in shallow mines: more likely to have sudden starts of violence when its reservoirs are invaded rapidly than when approached slowly; and the work which the air has to do increases as the area widens.

To meet these growing difficulties, a continually growing power of ventilation is needed in large and increasing collieries; and this is often practicable without great alteration of works. In other cases it is not practicable without providing a new upcast shaft; improving, enlarging, or multiplying the air channels and furnaces. If these amendments cannot be applied to a particular colliery, it should not extend its area or increase its activity of working; should open no fresh seam, re-open no old workings; should employ more extensively, or even exclusively, the safety lamp; and subject the operations to a severe and increasing vigilance.

To prevent accidents is the first duty of mine management; if accidents happen a new duty arises, viz., to reduce to the utmost possible degree their injurious effect. The fatal effects of explosions are direct or collateral. First in order is the direct effect of sudden heat and mechanical violence. Men are burned, battered to pieces, crushed or stunned by the heat and shock of the enlarged volume of air; they are struck by an air-hammer at points far removed from the origin of the force, even at the very top of the shaft if the explosion be heavy. Along the direct sweep of this terrible stroke nothing escapes; its lateral expansion bursts many of the walls and doors; and it breaks upward or downward through some of the crossings, on the completeness of which the right circulation of air in the mine depends.

Now follows a second order of effects. The violent expansion of air having destroyed in certain parts of the mine the doors, stoppings, and crossings, the atmosphere contracts again nearly into its old dimensions; part of the space which was occupied by fire becomes filled with the gaseous products of the fire, and that is, for the most part, poison. Thus what lives the heat and shock have spared, fall before the pestilential influence of the irrespirable gases which succeed. Nor is this all. Choke-damp is elicited from the goaf and fissures of the strata, in aid of that produced by combustion, great portions of the mines are "laid dead" by the interruption in the air currents; and thus more victims fall by the secondary than by the primary attack. In the last explosion at Hebburn, the traces of fire and mechanical violence were not co-extensive with the area of fatal result; and the circumstances of the mine were such that the air current almost

immediately returned to its right direction. Of those who perished, it is thought possible that some might have been saved had they remained in their working boards, the air in which was probably neither wholly driven out nor wholly contaminated by the "foulness" which found easier vent along the main roads.

But the exploding and collapsing forces do not break through all the walls and doors which separate the intake from the returns. As far as these remain and are effective from the shaft inward, the ventilation system remains; and, the momentary shock passed, the air resumes its right direction. As far as it sweeps the pit may be entered without the slightest dread, with the reasonable hope of recovering many whose life is only suspended. But beyond the free sweep of the air all is to be restored or supplied by temporary constructions, and thus hours are lost where moments are precious.

In this point of view how inexpressibly important is it that the plan of the mine should have been well designed; not only with reference to long periods of safety but to sudden bursts of danger; that, if possible, the fresh and foul air-currents should never be diverted from their course or allowed to have any chance of mingling at any point between the working places and the top of the shaft. That system of ventilation is the best, which, in ordinary working, keeps these currents most perfectly distinct, and, in extraordinary cases, prevents them from mixing to the farthest possible extent from the entrance and exit of the air. What then is to be said of an unfortunate colliery, whose bratticed shaft (constructed long since) is a contrivance by no means free from objection in every day work, and likely to fail altogether in a moment of danger?

The bratticed shaft has not a single defender among the intelligent mine agents of Durham and Northumberland; not one who having now to design the plan of a colliery would introduce this repulsive and ominous feature, the melancholy legacy of other days. The failure of the brattice shaft ruins the ventilation at its origin; but when downcast and upcast shafts are very approximate, and the drifts from them communicate by feeble double doors, and are only separated by many slight stoppings, the injurious effect of their yielding is obviously of the same kind. If the stoppings and doors remain firm along the main roads, they will probably fail in the districts where the air is subdivided, and at crossings where the two currents are only separated by a brick arch or a wooden floor. We may multiply doors and stoppings, and contrive ingenious crossings, and these are measures of utility; but something more is needed. Wide barriers or breadths of solid ground, or as solid replacement between the upcast and downcast shafts, and between the main intake and main return air channels, coupled with crossings in the solid ground, or otherwise made of impregnable strength, are

remedies easily provided in the first plan of a colliery, while the principle on which they are founded should never be lost sight of in works established upon any plan at any period.

The last consideration now to be entered upon regards the competency of the executive officers of the mine, and the degree in which the workmen are or can be made efficient auxiliaries to their own safety.

Abundant currents of air may be so misdirected as to yield bad ventilation; the safety-lamp may be so unwisely handled as to endanger the lives it should protect; the best regulations may, if not strictly carried out, become sources of mischief. The general remedies for these errors or crimes are instruction and responsibility,—increased knowledge, and stronger motives to use it rightly—knowledge is nowhere more powerful, obedience nowhere more necessary than in a coal mine. The superintending viewer, and the resident viewer, however frequently they may enter the mine, and however complete their knowledge of its peculiarities, require, for the success of their general arrangements, the aid of subordinate officers, trained to acquire and act upon that intimate and instant consciousness of passing occurrences which is necessary for the ordinary working of the mine, and upon the right use of which, in a moment of danger, the safety of the men may entirely depend.

Considering the importance of the trust committed to these officers, I have no hesitation in declaring my conviction, that one of the greatest boons to be conferred on the mining interest, one of the surest means for economizing industry and saving life, would be the establishment of local mining schools thoroughly suited to this most valuable class of men.

Notwithstanding the utmost exertions of the viewers and subordinate officers, there still remains what is perhaps most difficult of all to insure, steady good conduct in the men. The safety-lamp is a precious gift, very little liable to injury, but not proof against ignorance or imprudence. The hewers' occupation is neither so exhausting nor so long continued as to deprive them of all opportunity of gathering knowledge, and it seems desirable that they should be instructed in the circumstances which have an influence on their own safety. To acquire this knowledge by personal experience is exactly what the peculiarity of the case does not require; there have been enough of explosions, burnings, suffocations, and falls of stone, to serve as a basis for abundant teaching and warning.

Might not local mining-schools have a department specially suited to the wants of the collier, where he might see the effects of imprudence and disobedience, be gratified by explanations of many facts which he did not understand, and encouraged to prosecute his humble occupation with the satisfaction and self-respect which always spring from and reward the conscientious and intelligent discharge of duty?

DERBYSHIRE AND YORKSHIRE.

The coal-measures of Yorkshire, Derbyshire, and Nottinghamshire, including in this term the Millstone Grit (which in this district yields coal of some small value), constitute one great district between the magnesian limestone and the mountain limestone. Their total thickness is at least 3,000, and at most 5,000 feet; and of this coal constitutes about 60 feet.

The vertical section of the coal and ironstone measures of Derbyshire and Nottinghamshire exhibits in its total thickness of 3,000 feet, above 20 beds of coal, and several layers of ironstone, which vary in thickness and quality, so that in no one part of the district are all the beds workable, while there is perhaps none which has been everywhere left unworked.

The position of the coal-measures is generally such in Nottinghamshire, Derbyshire, and Yorkshire, that the beds dip to the eastward, so that in that direction occur the deepest collieries on each bed. Yet there are, especially in Derbyshire, several rather steep anticlinal risings and local changes of dip, by which the bassets of the coal-beds become complicated, and are often twice or thrice repeated. These circumstances have induced a more than usual amount of exploration and working along the basset edges almost continuously through the district; the short levels, and shallow pits, the work of centuries since, being traceable in many parts. The consequence is, that old wastes, the work of the old men, abound near the surface. In these wastes water often collects in great quantity ready to pour into the deeper works, if no barrier of solid coal, or an insufficient one, be left for protection; and, on the other hand, they form natural vents for the upward escape of inflammable gas. It is much to be regretted that accurate plans of these old wastes, and of the levels by which they were drained, are seldom now attainable, and thus sometimes serious loss, and often painful anxiety, are entailed on modern mine-owners.

DERBYSHIRE.

The most ancient of the workings in Derbyshire appear to be in the extremities of the district, as about Sheffield and Rotherham, Dronfield, Chesterfield, and Dale Abbey. Of the beds of coal, three, viz., the Black shale coal, the Deep hard, and Top hard, are the most continuous and regular, and perhaps the most valuable in the coal field. The intervals between them being pretty constant in thickness, they form excellent marks by which to identify and classify the smaller and less continuous beds. Of these coals, the Black shale, one of the bituminous or smithy coals of Derbyshire, yields, I believe, most inflammable gas (locally called sulphur), in the mine; but there is still a lower

bed, the Kilburn coal, which has somewhat the same character, and is also rather fiery. Perhaps the Top hard may be ranked next in the series of fiery coals.

Beyond cases of burnings from particular and very limited inflammations of fire-damp, the collieries of Derbyshire may be said to be less subject to explosions than those of many other districts. This comparative immunity from a formidable danger, may be as instructive as the contrary case of frequent accidents in fiery mines. It may be ascribed partly to the continual, though slow and imperfect upward drainage of the gas through the old wastes to the surface; partly to the slight depth and small underground area of the works, and partly to the method of working.

Until the year 1836, there was, I believe, no underground furnace set to ventilate any colliery in Derbyshire, though fire-pans, or coal-lamps, were occasionally hung in the pit, or in a lateral shaft, or placed at the bottom, to quicken the draught, by the more intelligent owners and managers.

Choke-damp is yielded by the old wastes (gob) and the fissures of the strata, so as speedily to stop the workings in unventilated shafts, bords, and headings. Water is only locally abundant. Many collieries are worked below level quite dry, a circumstance attributable to the generally retentive nature of the strata, and to the separation of the area into many portions by faults which are often impervious to water.

From what has been said it will appear that the collieries of Derbyshire are not placed under extraordinary difficulties or danger: yet there is enough, both of fire-damp and choke-damp, to accumulate in the comparatively still parts of the workings at sudden bends, in hollows of the roof, and along the edges of the gob, to require vigilant attention and a good current of pure air.

The system of working coal which prevails in Derbyshire, Nottinghamshire, and Leicestershire, is known by the title of long work, or working in banks. In this method, the working face of coal is called the bank; the roads which lead to this face, and afford a way for the coals which it yields, are called bord-gates, and these communicate with main-gates or roads, or inclined planes with jigs, which lead to the foot of the winding pits.

On reaching the bed of coal, the miner has the choice of commencing at once the excavation of coal in the space immediately round the pits, or of running drifts from them to some distance for systematically exploring the ground.

Supposing, at least, an island of coal to be left round the pits, and the exploring drifts to have proceeded some distance, the works may be commenced by pushing the working faces forward, or bringing them backward. By the former process, a large and growing space of old works is interposed between the pits and

the banks; by the latter, if fully carried out, the old works are left at the extremities, and the pits are surrounded by a zone of solid coal. Both of these methods are followed in Derbyshire, and there is by no means a conformity of opinion as to which, upon the whole, is preferable, the practice deviating one way or the other, according to peculiarities, some of which are local, and others spring from the method of excavation.

In long work three circumstances are mainly influential in the plan of the works: the structure of the coal, the direction of its dip, and the quality of its roof.

The Derbyshire coal is very regularly traversed by numerous visible and many hardly discernible fissures, in a direction about N.N.W. by compass; that is to say, about N.W. (true). The coal breaks off easily at these fissures, so as to show smooth vertical faces, which present themselves nearly to the S.W. (true); that is, in mining language, the coal faces the half-past two o'clock sun. This structure, looked at on the faces, is called the bord; and the termination of the parallel vertical plates is called the end.

By this structure the coal working is regulated. The getting of the coal being easier and cheaper when made bordways than endways; that is to say, when the line of the banks, and the undermining of the coal (technically holing), are made parallel to the fissures, so as to allow of the unsupported mass parting and falling easily. This happens in favorable cases even without the labor of wedging or blasting; the superincumbent weight causing the fissures to open and the coal to fall after the men have left the pit. The tenacity of the substance of the coal between the fissures is considerable, and when these are not crossed by a second set, the coal comes down in long prismatic masses (6, 12, or even 18 feet long) which lie parallel to the banks, and require to be broken by hammers. An important distinction is made between the hard coals and soft coals in Derbyshire; the former, of a dull aspect, slaty substance, and carbonaceous surface, may be exemplified by the Top hard or Deep hard; the latter, by the Deep soft, and other brightly-banded bituminous coals, with very numerous fissures.

The dip of the coal is generally eastward in Derbyshire; but, owing to some anticlinal lines directed N.N.W., it is locally turned to the S.W. and N.E. In these cases it is nearly at right angles to the end, or cleat, of the coal; a circumstance favorable, on the whole, to the arrangement of the works. For thus the bordgates will run nearly in the line of the dip or rise; the working faces (banks) will be nearly level, and may be pushed up the rise, or down the slope of the coal, in a neat and symmetrical manner. The general practice is to work up to the rise, because by this means the pressure of the ground above on the edges of the whole coal is, in some degree, *from* the face, and the coal is more advantageously removed.

This explains, in many cases, the working so much ground near the pits, and the formation of large areas of gob there, through or by which, for many years, the horse-roads and air-courses pass to the banks, which are further and further removed as the field of work extends.

The same desire to work to the rise causes a different arrangement when the workings are carried below level by dip bordgates. These are driven down the slope of the solid coal to such extent as may be thought suitable, and then the banks are opened out and wrought up the rise, or back toward the origin of the bordgates.

In the same pit, therefore, we may have coal worked outward (*i. e.*, the banks carried forward) toward the extremity, and coal worked inward (*i. e.*, the banks brought backward) from the extremity. We shall afterwards inquire into the effect of this on ventilation.

The third circumstance of general importance in long work is the quality of the roof. The large open spaces left behind the advancing banks are by degrees filled pretty closely by the partial breaking of the roof and general subsidence of the ground, and this breaking of the roof frequently follows very closely the working, so that at the small distance of a few yards behind the puncheons, set in one, two, or three rows, to keep a space open near the bank, the gob is already filled. But this varies with the roof; when that is a very solid sandstone (a rare occurrence in Derbyshire, except over the Deep hard) the ground is upheld for large spaces by the interlacing joints, and at last yelds with violent rending and a great fall. Such great falls happen less frequently with roofs of bind. In such roofs the layers above the coal drop first, then a second or third fall occurs, and so the gob is partially occupied before the general settling takes place, and subsidence is moderate and regular. The effect of heavy falls in ventilation may be dangerous: but they are also inconvenient to the workings. To moderate and direct the falls, so as to lessen their ill effect and irregularity, thick and discontinuous walls are built at intervals between the puncheons, the removal of which they facilitate; and these walls, constructed of materials which have fallen from the roof, are very useful in sustaining for a time the pressure of the ground and preventing its too great action on the working face; an action which would crush the solid, as well as displace the undermined part. These walls (technically packings) gradually yield, widen, and fall with the general sinking of the mass above, so that, unless in very shallow workings, no irregularity is used by them on the subsided surface. For such packings the strong binds, a common roof to coals in Derbyshire, is very convenient.

VENTILATION.

The effect of this system of excavation on the extrication and accumulation of noxious or dangerous gases remains to be considered. In the first place it is to be remarked that though much of the carburetted hydrogen is drained from Derbyshire coal, by the numerous channels and old workings left by the old men, by many faults of a bold character, and by several anticlinal elevations; still the coal yields gas with sufficient freedom to require strong ventilation, and justify the expectations that hereafter, as the pits grow deeper, the Davy lamp must be put in more frequent operation than it is. The extrication of gas from the deeper parts of the coal-beds appeared to me nearly equal to the average of that which is yielded by the seams on the Tyne. But there appear to be few cases of blowers worthy of notice. When in addition to the natural vents for gas, the air channels are carried forward by exploring drifts, both endways and bordways, much ahead of the working faces, so as to tap the faults and open the ground, the gas escaping by the ends of the coal is easily drained off, and the banks are safe from all but slight explosions, if there be a strong, steady current of air between them and the gob. As the works proceed gas continually comes off from the coal, roof, and floor; and, though not very abundant, its natural tendency to ascend will weaken or neutralize the mechanical effect of the air to mix with it, and small patches of inflammable air will collect in the higher angles (rise ends) of the banks, in the inequalities of the roof, and in parts of the gob, unless there be (and sometimes even notwithstanding there be) strong ventilation.

In long work, therefore, it is a good principle to carry the air in one great body by the working face: to have the space here kept carefully free from impediment so as to allow of a constant wall of air between the fresh coal and the gob. In this full stream of air the candles may require protection, but no encouragement should be given to the colliers, or managers, in their often repeated assertion, that there is too much air, and that the men cannot bear it. In long work the great defence against danger, is a strong stream of air, and this is nowhere more deserving of attention than in Derbyshire and Yorkshire, where the works are growing deeper and the difficulties are augmenting.

The air channels for long work present two conditions worthy of notice. When the working is to the rise of the pits, and the gob is spreading upward and outward, the air, after passing along the main-gate, or by some other channel in solid coal, and reaching the working district, is carried by a bord-gate, one side of which is solid coal, and the other is a packed wall, or between two such packed walls, to the face and returns from it by a drift, one side of which is packed to a channel in solid coal. It thus

goes round or through the gob, by a course continually growing longer, and is liable to be sucked out of its circuitous course by the innumerable fissures of the fallen and displaced materials. From some experiments which I have made this leakage appears to be considerable. Its effect must vary. It is upon the whole a kind of ventilation of the gob; but there are cases very conceivable, when it may merely add air to gas, and thus make an explosive atmosphere. A candle taken into the gob in such a state would cause instant explosion, and unsuspected or very great falls in the gob may drive out the inflammable air and cause ignition. The chance of such ignition is augmented by the frequent passage of trams up and down the gobbing gates, which are either deprived of circulating air altogether, or furnished with doors scaled to give a limited supply. However, it must be added that the gob is generally found not to contain much gas near the banks, in the present state of Derbyshire workings.

The other condition obtains when the working is on the deep side of the pit and returning toward it, the gob being left behind, to the deep and solid coal remaining to the rise. In this case the air channels, both entering and returning, are in solid coal; the current sweeps only one surface of gob, viz., that near the bank or working face; the channels grow continually shorter and shorter, and are not liable to much leakage; the ground is proved to the rise by the air channels driven in the solid; and if well explored right and left along the level courses the mine is in a good condition. But if not so explored, a fault encountered in these deeper workings may yield gas enough to be termed a blower and endanger the mine. As usual in other districts the gob of Derbyshire is fully as liable to yield carbonic acid gas as fire damp, and perhaps fully as much mischief may be ascribed to its slow poisonous effect, as to the sudden violence of carburetted hydrogen. The remedy is the same in each case—strong ventilation. Let us see how far this is provided.

There are always two, and sometimes more, pits, and it is by the regulated communication between them that the due circulation of air through the mine (the ventilation) is obtained. If the pits are two, and, as generally is the case, they are placed within a few yards of each other, one of these is commonly employed for pumping the water, and the other for winding up the coal; hence the names of engine-pit and winding-pit. In some collieries and iron-stone * workings of limited extent, the circulation of air which takes place is unassisted by a direct force: such as the draught of a furnace, the use of a fan, steam-jet, air-pump, or water-flash; and the ventilation of the mine depends on the natural peculiarities of the surface, the force and direction of

* Ironstone is generally got to the depth of 20 or 30 yards by bell pits, at greater depths in banks like coal.

the wind, and the influence of the artificial works of the mine. Of these none are unimportant, there is almost always a definite tendency of the air to pass down one of the pits, and up the other; but this is liable to cessation, and even reversal, on the recurrence of particular atmospheric changes. If one of the pits be employed for pumping, it is generally cooled by the wetness which mostly attends the process; if the other be employed for winding, and the ascent and descent of men, there is some warmth generated in it and the nearest parts of the underground workings, thus, the former (cooled) becomes a downcast shaft, the latter an upcast shaft; the air descends the pumping-pit, and ascends the winding-pit, with a feeble velocity, insufficient for an extended underground area, and liable to obstruction or suppression if the works are suspended or prosecuted irregularly. In such collieries there is properly no system of ventilation; no regular employment of ventilation force. (Similar remarks apply to iron-stone mines, and, indeed, to a great number of lead and copper mines.) The current of air in such collieries is variable with the weather and the working. It is insufficient for a large area, and even in very limited works the air cannot everywhere be changed with sufficient activity to maintain the flame of a candle. When from local obstruction, extent of workings, or peculiarity of weather, this happens on a working-face, or any part of it, the men retire, or use some temporary expedient for agitating the air about the place of their work; or a basket, or cage of burning coal, (technically a fire-pan,) is suspended by a chain, and let down the pit, or placed at its base, to increase or create a draught. By this method the circulation may be for a time forced; but the expedient is too inconvenient to redeem the collieries where it is practised from the class of mines without systematic ventilation force.

[To be continued.]

Art. II.—MINERAL WEALTH OF THE UNITED STATES.*

We notice Professor Wilson's interesting report on the mining and metallurgic position and prospects of the United States. Their peculiar geological features, as seen in the enormous development of the older formations, early indicated the probable possession of mineral wealth, and every State that, from time to time, became sufficiently important to be added to the federal Union, brought with it a dower, not more valuable from the surpassing fertility of its surface acres, than from the hidden riches which lie beneath them. The distribution of the metallic min-

* London Journal.

erals in the different States is, however, somewhat irregular, the rarer metals and gold being found but in few localities; tin only to a limited extent in one place; lead and copper are generally seen associated together, occurring to a greater or less extent in most of the States; while iron is met with everywhere, in some places forming deposits of enormous magnitude, and in others compensating for its diminished quantity by the richness of its ores. The iron ores found in the States comprise every variety known in Europe, save, perhaps, that of our country known as the "blackband." Those principally used for smelting are the magnetic oxides, the hematites, and the clay carbonates of the coal measures; besides these, the "spathic," or "sparry carbonate," and the "oligist," or specular iron ore, are used, but at present only to a limited extent. The magnetic oxides and hematites are dispersed pretty generally throughout the whole extent of the Union, and the clay carbonates are associated with the coal measures lying west of the Appalachian chain—in general they are not so rich as those in our own country; but, when mixed with the hydrated hematites, these lean ores are advantageously worked. In 1830, anthracite coal was successfully used in smelting ores; and when, some years later, it was shown that the hot-blast could be as advantageously applied to anthracite as to other furnaces, Pennsylvania became at once the great centre of the industry, and speedily assumed the control of the home market.

The manufacture of iron has hitherto distributed itself on the line of eight great rivers—the Housatonic, Hudson, Delaware, and Lehigh, Schuylkill, Susquehanna, Potomac, Ohio, Cumberland, and Tennessee. The make of the first division cannot be estimated at more than 10,000 tons per annum, which are consumed, chiefly in the immediate districts, in the manufacture of cast-iron railway-wheels, and malleable iron castings.—2d. The Hudson River traverses the State of New York, and on its line are six large anthracite furnaces; on Lake Champlain, three more; and the rich ores of the deposit deriving its name from that lake are said to work up well by themselves in the anthracite furnaces, without the admixture of any leaner ores, with a less consumption of fuel, from one-third to one-fifth of coal being sufficient to produce one of metal. These advantages all tend to reduce the cost of anthracite iron-making in the Hudson district, which Professor Wilson had every reason to believe could be made on tide water at an average of $18 per ton. The quantity made is rapidly increasing, and it is stated that the returns for the current year, 1853–4, will not be less than 80,000 tons.—3d. The Delaware is the next great river, south of the Hudson; in this district are the most extensive and successful iron-works in the United States; and iron can be made on the Lehigh at as cheap a rate as at any other spot in the Atlantic States. In the

establishments visited, economy of production was found to be adhered to, the air being heated by the waste gases of the furnace; and in most cases, the steam power, whether for driving the blast or for other purposes, was generated in boilers set in the upper part of the furnace, and arranged so that the heated gases played around them. The aggregate produce of the district may be taken at 110,000 to 120,000 tons per year, which will probably be increased, as new furnaces of the largest class are in progress of erection. Owing to the advantageous position of the furnaces on the Lehigh, and the scale upon which they are worked, it would appear that the actual cost of making iron there would not exceed from $14 to $16 per ton.—4th. The Schuylkill takes its rise in the south-western extremity of the first great coal basin, and, pursuing an eastern course, runs into the Delaware a short distance below the city of Philadelphia. An estimate of the expense of making iron, drawn up in 1850, makes the then average price per ton $17,50, since which period, prices, both for materials as well as labor, have risen fully 25 per cent. Upon this river there are in operation 18 blast furnaces, using anthracite coal; but these furnaces are of smaller capacity than those on the Lehigh, and their total production may be taken at 100,000 tons per annum.—5th. The Susquehanna is another of the great parallel rivers; in one portion of its course it skirts for many miles the south-western extremities of the first and second coal fields, and the western branch, into which it divides, traverses the centre of the third, the great "Wyoming" basin. Along its bank large deposits of iron ores are met with; iron can be made in the district at a price averaging from $15 to $18 per ton; and in some of the most favorable cases, where the furnaces are in immediate proximity to the ore and fuel, it can probably be made at $2 to $3 per ton less. The iron industry of the Susquehanna is in a prosperous state; the production is already very considerable—not less than 120,000 tons will probably be made in the present year, the greater part of which finds a ready market west of the Alleghanies. Pennsylvania furnishes, in round numbers, one half of the whole production of iron in the Union. The entire number of furnaces in the State, in 1850–1, was 304, and the actual make 198,813 tons.—6th. The Potomac is the next of the great rivers, taking its course some 60 to 100 miles south of the Susquehanna, and running into Chesapeake Bay about midway from the ocean; and in the district is included the production of Virginia and Maryland. The district is abundantly supplied with ores, chiefly hematites, of good quality. Charcoal is the fuel chiefly used, although the increasing means of communication with the Cumberland coal basin, and with the anthracite region of Pennsylvania, must afford great advantages in the way of fuel to the furnaces placed within reach of the lines of transport. The present cost of coal-iron in this district may be taken at an

average of $20 per ton; while charcoal-iron cannot be made at less than $25 to $30 per ton. The gross production of iron of this region may be estimated at 125,000 tons, of which Maryland returns about 100,000, and Virginia about 25,000 tons.—7th. Professor Wilson has classed together the two divisions, the Ohio and the Cumberland and Tennessee, not having been able to procure any satisfactory information as to the details and present condition of the iron industry of either. As the demands of the western markets are being supplied by western production, from the best estimates he could obtain the production could not be less than 150,000 tons for the past year. The iron-making facilities of the Western States are yet only partially displayed, but the enormous area occupied by the great Appalachian coal-field secures the possession of an illimitable supply of fuel; while the well-defined existence of beds of clay and iron ore, associated with the coal measures, places the raw material under conditions most advantageous to the manufacturer. These, however, have hardly as yet been rendered fully available to iron-making. Charcoal as fuel, and the hematite ores found on the outskirts of the coal-field, supply the principal portion of iron now produced; and the present cost of making cannot be less than $20 per ton.

If these estimates are correct, the entire production of the States for the year 1853–4 may be taken as 805,000 tons; while the gross amount of iron produced in the several States of the Union for the preceding year, 1852–3, is given at 540,755 tons; the number of hands employed, 20,298; and the market value of the produce, $12,489,077. Taking the present production of pig-iron at 800,000 tons, about one third of it is consumed for castings, and the rest is convertible into wrought-iron, at a loss in waste, &c., of about one third, which, for practical purposes, reduces the total or available production about 130,000 tons, and leaves, in round numbers, 600,000 tons, to meet a consumption of not less than 1,200,000 tons; and the deficiency must be supplied by the produce of other countries. The Treasury Returns state the number of establishments for the conversion of pig into wrought-iron at 422, giving employment to upwards of 13,000 workmen; and the entire amount manufactured in the States may be taken at 500,000 tons per annum.

A process, patented by James Renton in 1851, for making wrought-iron direct from the ore, is being carried out on a commercial scale at Cincinnati, in Ohio, and at Newark, in New Jersey. Professor Wilson visited the latter establishment, and the working returns that were furnished to him were certainly very satisfactory, although the operation, which has been several times attempted, has never been successful in this country. The report explains the process in detail, and points out the difficulties to be overcome.

He also mentions another point of interest in connection with

this industry—the method of utilizing the slags of iron furnaces, illustrated by Dr. W. William Smith, of Philadelphia, in the New York Exhibition, in Class XXVII., where a collection of bottles, slabs, bricks, and other articles, run direct from the reducing furnace, were exhibited. The finish and appearance of the various articles would justify the expectation that the process, if applicable to the slags of coal furnaces generally, would be of great industrial importance, the price being about four cents per cubic foot for slabs. We notice this productive use of the refuse of furnaces as well worthy of attention in the vast iron-works of these islands.

Art. III.—THE BLACK BAND, OR MUSHET IRON-STONE.*

This anticipation in the text has been singularly realized; and in the discovery of what is now called the Black Band iron-stone, an entirely new class of iron-stone, to which I have given the name "carboniferous," has been introduced to the iron trade and to the mineralogist. Others have termed it bituminous; but this designation is not, as far as I have seen or known, at all appropriate. In fact, all iron-stones of this kind, that have hitherto come under my notice, may be considered as a species of coal, which, when exposed to combustion, yields a greater or lesser quantity of smoke and flame, leaving behind what may properly be named a metallic coke. The different beds generally contain a sufficient quantity of carboniferous matter to torrefy the stone, and make it fit for the furnace. Most of the beds possess a top measure which is more carboniferous than the lower measures—more resembles a carboniferous schist—and in proportion as it contains volatile matter resolvable into flame, so is its percentage of iron reduced. The fracture of the lower part of the bed generally presents gray and black layers alternating; and at no time, unless when in contact with trap, does the Black Band possess a specific gravity equal to that of the common class of argillaceous iron-stones.

The discovery of this stone took place in the year 1801, in crossing the river Calder, in the parish of Old Monkland, and—as the entry now stands in my memorandum-book—a little way above Cairnhill Old Mill. I soon ascertained that it belonged to the upper part of the coal formation, and near to, or above the Ell coal. Having satisfied myself of its value, I prosecuted my researches in other quarters, and another and a richer bed was discovered in the lands belonging to Clifton hill, Airdrie House,

* David Mushet.

Burnfoot, Kipsbyre, Roughsoles, &c., &c. This bed was found under the crop of the Glasgow splint, or fifth seam of coal, and has since been ascertained to lie about fifteen fathoms under the same. Soon afterwards it was found in the extensive estate of Woodhall, first in the Kennel burn, and then on both sides of the river Calder and in the lands of Lauchope. The exact geological position of the Woodhall carboniferous iron-stone has not yet been determined. I have been accustomed to consider it as belonging to the small coals that are found in the lower part of the coal field, approaching to the mill-stone grit. A fourth bed of considerable thickness has been found, but I am not informed of its geological position, and it is, I believe, not rich enough in iron to be worked while so much superior iron stone is to be had. About two years ago, a bed of carboniferous iron-stone was found in Ayrshire, where furnaces are erecting for its consumption. Nearly at the same time, two beds of the same class of iron-stone were discovered on the Dryden estate, about six miles south of Edinburgh, the analysis of which will be found in the proper place. The Black Band is also worked in North Staffordshire, under the name of Red Mine, and traces or veins of it are met with, and partially worked in South Staffordshire and in North Wales. I have examined the section of the South Wales mineral basin, but without finding in it any thing at all resembling any of the Black Band beds before described or referred to.

In order to throw as much light as possible on this valuable ore of iron. I now subjoin, in addition to Dr. Colquhoun's analysis of the Airdrie Black Band, given in the preceding note, the following analysis presented by Dr. Thompson at the meeting of the British Association at Liverpool, in 1837.

Analysis by Dr. Thompson of the Airdrie Black Band, or that found under the splint coal.

Carbonate of iron	85·44
Carbonate of lime	5·94
Carbonate of magnesia	3·71
Silica	1·40
Alumina	0·63
Peroxide of iron	0·23
Coaly matter	3·03
	100·38 parts.

The next analysis which I am enabled to give is by Dr. Colquhoun of the Cairn-hill Black Band, being the measure connected with the Ell coal, and the first that was discovered.

Carbonic acid	26·41
Protoxide of iron	40·77
Lime	·90
Magnesia	·72
Clay	10·10
Coaly matter	17·38
Iron pyrites	2·72
Water	1·00
	100 parts.

Practically, Dr. Colquhoun considers 100 parts of this stone to contain—

Iron	33
Earthy matter	10
Coaly matter	17
Sulphur	1½
	61½ parts.

The difference between this analysis and the former one made by Dr. Colquhoun, consists principally in the great increase of coaly matter, which

In the present one is	17·38
In the former analysis	3·03
Difference	14·35

In the former analysis, the protoxide of iron was .	53·03
In the last, the protoxide of iron is	40·77
Difference	12·26

The excess of coaly matter most probably arose from Dr. Colquhoun having pounded up the whole vein, including the top parting, which always contains a considerably greater quantity of carboniferous matter, and a much less quantity of iron.

Another specimen of the Black Band from the parish of Cadder was analyzed by Dr. Colquhoun as follows:—

Carbonic acid	34·39
Protoxide of iron	53·82
Lime	1·51
Magnesia	0·28
Silicum, earthy matter	2·00
Coaly matter	7·77
Iron pyrites	0.23
	100 parts.

Practically considered—

Iron	42·00
Earthy matter . . .	3·79
Sulphur	0·12
	45·91 parts.

Having thus, by referring to the results of humid analysis, endeavored to convey some idea of the nature of the Black Band, or carboniferous iron-stones, we will next proceed to the particular circumstances of the discovery, and to those early experiments, in the dry way, which first ascertained the valuable properties of this new class of iron-stones, reserving for a separate note some account of the extensive manufacture of iron which has been established in consequence. In a discovery which has proved of considerable national importance, I hope I may be excused in copying, nearly verbatim, from one of my contemporary memo-

randa the details of the first experiment that gave metallic existence to the iron contained in these ores. The iron-stone is thus described:—"The appearance of this iron-stone resembles that of a heavy parrot or cannel coal. It comes away in two beds, the upper about four inches thick; the lower, and more solid and dense part, ten inches. It lifts in lengthened oblong squares, stretching out like a pavement, and sometimes in triangular masses. Its fracture is gray-black, striped with whitish-colored laminæ. The iron-stone rests upon a bed of parrot coal one inch thick, and parting in strips of about two inches in breadth. Below this is found a soft fine clay, which will serve for good holing. The incumbent strata are a coaly schist immediately over the iron-stone, and above this a fine parrot or cannel coal, capable of receiving a good polish; a foot of soft iron-stone blaes becoming coarser as they approach some free-stone plies or beds."

My first step was to burn several pieces of the iron-stone together. These were found to flame upon being introduced into the fire, and to open into their laminæ, which, when cold, pounded into a reddish-purple-colored powder, denoting the presence of a considerable percentage of iron. The powder was attracted by the tongue, and obedient to the magnet; and it deflagrated with coaly sparks in a candle, a proof that there still remained in the calcined iron-stone a portion of the carboniferous matter. Having thus ascertained the existence of iron, I placed in a furnace for roasting, a quantity of the raw Black Band,

Weighing	6236	grains.
After six hours' exposure to a steady heat, the Black Band was taken out, and found to weigh . .	3197	
Equal to 48 and 7-10th per cent. Lost in roasting	3039	

The general appearance of the burnt stone was nearly the same as that already described, with the exception of two thin ribs of a blue metallic color, which brightened under the file. The whole was pounded together, and the first assay of the ore was made with the following quantity:—

Black Band calcined	1571	grains.
Blue Irish limestone, in powder	1093	
Bottle glass	666	
Charcoal (as it happened from the rind of the oak)	109	
	3439	grains.

The mixture was safely fused, and at the bottom of the crucible was found a button of white cast iron, which weighed 992 grains; equal to 63¼ per cent. from the roasted stone, or 32½ per cent. from the stone in the raw state. So much for the product of the whole measure taken together, including the top and bottom parts.

My next step was to ascertain the comparative richness in iron of the two beds into which the vein was divided.

Part of the upper bed weighing	9740 grains.
was placed raw in a bright red heat, and exposed for five or six hours, during which time it emitted a considerable quantity of dark coaly flame, which eventually became clear and gray	
The residuum weighed	4530
Lost in roasting	5210 grains.

Equal to 53½ per cent.

The roasted stone exhibited an alternation of red and white schist, the former containing the iron, and the latter the stony residuum of the carboniferous part. Towards the lower edge of the crucible, where the contents had been more sheltered from the action of the air, were found several thin plates of flexible iron, each two or three square inches, resembling what is known in the iron trade by the name of lattin plate, which twisted and bent with facility, but with a considerable degree of stiffness. The whole, with the exception of two of these curious malleable leaves of iron, was pounded together and assayed as follows:—

Black Band, upper bed calcined	1812 grains.
Burnt lime	1812
Bottle glass	1812
Charcoal	200

The result of the fusion of this mixture was a white porcelain glass, tinged with blue, a carbonated button of iron, and some globules, weighing together 448 grains, equal to 34 per cent. from the roasted stone, and 16 per cent. from the raw. Another trial was made with this upper bed, and the result proved equal to 21 per cent. This difference in the analytical result at different times is accounted for by the varying texture of this part of the iron-stone bed.

Some parts of the ten-inch, or lower bed of the Black Band were now roasted together, and during this operation a quantity of flame was discharged, and a loss of weight sustained in the roasting amounting to 44·8 per cent. In another experiment, where the temperature was higher, the loss of weight was as great as 48½ per cent. Some of the most metallic of these roasted pieces were introduced into a close vessel in contact with charcoal, and heated for three or four hours, when they were found firmly welded together, and in the state of soft or malleable iron. On the average of a number of experiments, the upper bed was set down at from 20 to 21 per cent., and the lower, or ten-inch bed, at from 34 to 35 per cent.

In pursuing these assays, some difficulty was at first experienced in apportioning the charcoal, from the circumstance that the roasted iron-stone still contained some of the original carboniferous matter of the ore, which, in many of the trials, occasioned so great a redundancy of carbon in the crucible as to retard wholly, or in part, the fusion of the mixture. This obstacle was

at last got over by presenting to the flame as much as possible of the surface of the roasting ore, so as to convert the whole into an iron-bluish-gray color, in which state the ore was found to be easily regulated and smelted with the usual proportion of carbonaceous matter, and with steady and regular results both as to the quantity and quality of the iron.

Bearing in mind the principle established in the first note—namely, that in fusing an oxide of iron of 70 or 72 per cent., two or three grains of iron are revived for each grain of charcoal present—some of the Black Band from the lower bed was ground fine and fused, *per se*, with a view to deduce from the quantity of iron revived the proportion of carbonaceous matter contained in the ore. Four hundred grains of the raw stone fused alone, produced a button of soft steel which weighed 87 grains, equal to 21¾ per cent. The glass over the button was slightly porous and metallic, but exhibited, where the edges were thin, an amber color. The same experiment was repeated, but, from the fusion coming on too rapidly, with a high temperature, the quantity of iron revived was only 72 grains, equal to 18 per cent. At the rate of two grains of iron for one grain of charcoal, it was inferred that there existed in the 400 grains of raw iron stone, carbonaceous matter to the extent of 43½ grains in the one case, and 36 grains in the other; or, forming in the first experiment about 1-9th of the weight of the iron stone, or 11 per cent., and in the latter 1-11th, or about 9 per cent. Average 10 per cent.

To ascertain whether the whole of the carboniferous matter was expelled during the process of roasting, 400 grains of the roasted stone were fused, but no metal revived. Four hundred grains of the same stone, and 13 grains and 1-3d of charcoal, or 1-30th the weight of ore, were fused, and a honeycombed metallic glass resulted, but there was no trace of iron, although a small cell, as on similar occasions, was formed at the bottom of the glass ready for its reception.

Roasted stone	400 grains.
Charcoal 1-20th, or	20

When fused, yielded a spherule of iron, weighing 10 grains, or 2½ per cent. Again—

Roasted stone	400 grains.
Charcoal 1-15th, or	26 6-10th.

Were perfectly fused, and a large globule of iron obtained, which weighed 32 grains, equal to 8 per cent., being less than 1¼ grains of charcoal. Again—

Roasted stone	400 grains.
Charcoal 1-10th, or	40

When fused, produced 63 grains of iron, being nearly 1¾ grains for each grain of the charcoal employed.

Roasted stone	400 grains.
Charcoal 1-7th, or	55¼

When fused, yielded a button of soft iron, weighing 132 grains, or 33 per cent., being nearly 2½ grains of iron for each grain of charcoal. When fused again with 1·5th and 1·4th of its weight of charcoal, an accumulation of carburet, from the excess of carbon and the absence of flux, began to take place, and to limit the increase of yield from the ore. With 1·5th its weight of charcoal, the iron reached to 45 per cent., and with 1·4th, to 45½ per cent.

The only other experiment which I will now mention, was an attempt to reduce the iron into a metallic state without the presence of carbon. Some of the lower bed was placed in a close vessel surrounded by and embedded in charcoal, the whole being made air tight.

The iron stone weighed	1521 grains.
and was exposed for six or eight hours to a good bright heat. It was afterwards removed from the charcoal-dust, washed and dried, and found to weigh . . .	1004
Loss equal to 34 per cent.	517

The ore had acquired a black color, was extremely friable, and deflagrated when strewed in the flame. Three hundred grains of it, fused alone in a crucible, yielded 147 grains, equal to 49 per cent. from the de-oxidated ore; and in another trial 200 grains yielded 90 grains of iron, or 45 per cent. The reduction of the ore on the present occasion was attributed to the severe de-oxidation which it had undergone, assisted either by a minute portion of carbon, which may have penetrated the ore by a species of capillary attraction, or a part of the carbon originally combined in the stone not carried off during the cementation, or by both united.

ON THE APPLICATION OF BLACK BAND TO THE MANUFACTURE OF PIG IRON.

For several years after its discovery, the use of this iron stone was confined to the Calder iron works, erected by me in the years 1800, 1801, and 1802, where it was employed in mixture with other iron stones of the argillaceous class. It was afterwards used in mixture at the Clyde iron works, and, I believe, nowhere else; there existing on the part of the iron trade a strong feeling of prejudice against it. About the year 1825, the Monkland Company were the first to use it alone, and without any other mixture than the necessary quantity of limestone for a flux. The success of this company soon gave rise to the Gartsherry and Dandyvan furnaces, in the midst of which progress, came the use of raw pit coal and hot blast—the latter, one of the greatest dis-

coveries in metallurgy of the present age, and, above every other process, admirably adapted for smelting the Black Band iron-stone.

The greatest produce in iron per furnace with the Black Band and coal blast, never exceeded 60 tons a week. The produce per furnace now averages 90 tons a week. Ten tons of this increase I attribute to the use of raw pit coal, and the other twenty tons to the use of hot blast. With raw pit coal less blast is required to produce the same quantity of iron, or, in other words, the same quantity of blast will produce a larger quantity of iron, even where cold blast is employed. This arises, not from the greater quantity of iron mine which the raw coal is found to smelt, but from the greater solubility of the coal before the blast, *driving more charges*—as it is technically called—and increasing the quantity of pig iron made in a given time, by increasing the consumption of iron-making materials. The ratio of increase with cold blast and raw pit coal, may be considered equal to about 25 per cent. The increased quantity of iron produced by the hot blast is not owing to any material increase in the consumption of coal, but to the circumstance that the hot blast renders the coal capable of smelting and carbonizing a much greater weight of iron ore. The quantity of pig iron will, therefore, depend on the rate of *driving*, and the weight of iron-stone apportioned to the fuel. The rate of driving will depend on three things, namely, the quantity and strength of the blast, the solubility of the coal, and the fusibility of the iron-stone. The fusibility of the latter will depend partly on the nature and proportion of the earths they contain, and partly on the quantity of limestone required to promote fusion, and form a cinder sufficiently divided to allow the descending iron to penetrate into the hearth of the furnace. Whenever the earths exist in quantity, and are of a refractory nature, a great deal of limestone is required, as much, sometimes, as 1½ tons to a ton of pig iron, and with roasted argillaceous ores, not less than one third the weight of the iron-stone of limestone is employed. With the carboniferous iron-stone, the proportion of earth in which seldom exceeds 5 or 6 per cent., only a small addition of lime is required to neutralize the earthy matter, and since the hot blast system has done away with the necessity of having a flow of cinder for the protection of the iron, considerably greater than the quantity of the iron itself, ores of the richest quality may now be safely smelted. Instead of 20, 25, or 30 cwt. of limestone formerly used to make a ton of iron, the Black Band now requires only 6, 7, or 8 cwt. to the production of a ton. This arises from the extreme richness of the ore when roasted, and from the small quantity of earthy matter it contains, which renders the operation of smelting the Black Band with hot blast, more like the melting of iron than the smelting of an ore. When properly roasted, its richness ranges from 60 to 70 per cent., so that little more than

a ton and a half is required to make a ton of pig iron, and as one ton of coal will smelt one ton of roasted ore, it is evident that when the Black Band is used alone, 35 cwt. of raw coal will suffice to the production of one ton of good gray pig iron.

The following list exhibits the number of blast furnaces now at work in the parish of Old Monklands, smelting the Black Band alone, to the exclusion of any other iron-stones, and averaging about 90 tons each per week.

Monkland	3
Calder Bank	2
Calder	6
Dandyvan	5
Carnbra	2
Gartsherry	8
Sommerlee	4
Total	30 Furnaces.

Besides these thirty furnaces, there are four at Clyde and two at Govan which use the Black Band in mixture with about half its weight of common clay iron-stone. It may therefore be reckoned that there are in the neighborhood of Glasgow, thirty-three blast furnaces working upon this valuable iron-stone, making weekly about 3000 tons of pig iron, consuming weekly about 9000 tons of raw ore, less than an equal number of tons of coal, and 1000 tons of limestone. According to the old mode of calculating, which allowed ten tons of materials to make one ton of pig iron, it would have required 30,000 tons of coal, iron-stone, and limestone to produce the above-mentioned weekly quantity of iron. The production is now effected with 19,000 tons, making a saving of 11,000 tons a week, or, upwards of 3¼ tons of materials in the manufacture of each ton of pig iron.

After an absence of many years, I visited Scotland this summer, and in addition to the existing active state of the trade in the Monkland parish, arising out of the discovery of the Black Band, I found considerable preparations making for a further extension of the manufacture of pig iron.

At Gartsherry preparations are making to erect	6 furnaces.
At Dandyvan	3 or 4
At Calder	1
At Calder Bank	1
At Govan	2
	13

This prosperous state of affairs not only abundantly enriches the iron masters who are in possession of the carboniferous iron-stone, but has raised in an unprecedented manner the value of the mineral property in the neighborhood of the furnaces. The estate of Airdrie, for instance, now returns to the proprietor, for royalty on the Black Band discovered by me in 1801, 12,000*l.* a

year; whereas, formerly, not one shilling of mineral rent was obtained. Large revenues are also derived from the Cairn-hill, Lauchope, Woodhall, and other estates, all originating in the same source.

The lordships payable upon the raw iron-stone are from sixpence to four shillings and threepence per ton; but the rent is generally taken upon the roasted stone which is calcined at the pit's mouth, and which, owing to the carboniferous matter got rid of in the operation, is reduced to half its original weight; thus materially reducing the cost of carriage on a ton of pig iron. The inflammable nature of the stone is such, that little or no addition of fuel is requisite to calcine it. The lordships payable on the roasted stone are from four shillings to eight shillings and sixpence per ton, long weight. A blast-furnace, with hot blast, which would make from the common argillaceous ore 60 tons of pig iron a week, would, with the carboniferous iron-stone alone, manufacture from 80 to 90 tons.

ART. IV.—SALT AND GYPSUM OF THE PRESTON VALLEY OF THE HOLSTON RIVER, VIRGINIA. BY PROF. HENRY D. ROGERS.

VIEWED in any of its aspects, topographical, geological, or commercial, the Preston Salt Valley, of Washington County, Virginia, is one of the most interesting tracts in the whole diversified range of the Appalachian Mountains. In a district adorned with far more than the usual share of the impressive and pleasing scenery which belongs to the mountain chain of the country, this immediate locality is remarkable above the rest for the picturesqueness of its features. This pre-eminence it derives in a large degree from the same rare combination of geological conditions which concentrated within it, its amazing accumulations of salt and gypsum.

The valley of the north fork of the Holston, of which the Preston Salt Basin is a portion, though shut in by lofty and massive sandstone mountains on its north-western and south-eastern sides, possesses, in a longitudinal network of lesser short crests and steep insulated knobs, and of included deep ravines and winding valleys, an uncommonly rich and beautiful interior topography. An extensive and profound dislocation of the strata, running lengthwise through this valley, and parallel with the main mountain ridges which inclose it, combined with a series of transverse lateral disruptions, branching apparently from this main one, seems to have imparted an unusually wild play, and energy, and cutting power, to the waters that shaped the hills and grooved out the ravines between them. To this deep and varied carving of the surface, the unequally resisting nature of the

materials—which are hard sandstones, cliff-forming limestones, and soft, easily excavated marls and slates—have contributed in no small degree. A rich, brown soil, a product of the decomposition of the limestones and calcareous and ferruginous clay rocks of the country, clothes the slopes and hollows of this belt of hills with a highly luxuriant vegetation, softening the harshness of the rougher places, and making the wildest portions of the scenery picturesquely attractive.

In the middle of this chain of hills of the Holston Valley, lies, beautifully encircled by fertile, indented slopes, and a chain of knobs and spurs, the small, but remarkable valley of the salt works and gypsum quarries of the Preston and King estates. The bed of the valley is an oval-shaped plain, of rather more than 300 acres in extent, as smooth as a bowling-green, but not as level, having a gentle, uniform slope from its south-eastern to its north-western side, or towards the Holston River. From this rapid stream it is separated by a nearly straight range of variously shaped limestone knobs, between whose fertile sides descend ravines into the pent-in basin, which discharges its collected waters into the river through the deepest of these transverse passes. On the opposite or south-eastern side, the plain is half engirt by a semicircular sweep of mountain or a crescent-like indentation in the flank of the bounding ridge. The soil of the valley is wet and peaty; and beneath it, to an enormous depth, there appears to be no solid rock, but a deposit of clay and earth embedding in places large bodies of rock salt and of gypsum, and saturated in its lower portions with highly concentrated brine.

The Preston Estate, which embraces all but the south-western end of this valley, has a total area of about 6000 acres. It is bounded north-northwest by the crest of the Poor Valley Ridge, the mountain immediately to the north-west of the Holston River. Its south-southeastern limit is on the southern slope of the Little Brushy Mountain, a subordinate range of the Walker Mountain. Of the whole tract an important portion consists of admirably fertile limestone land. The "Rich Valley," so named, deriving its fertility from a limestone soil, immediately adjoins the estate, on the south-east. Of the remainder of the property the chief part is slate land, with one or two crests of sandstone; but even the soil over the slate is quite productive. The interesting smooth plain, above referred to, containing the salt and gypsum, lies not far from the centre of the estate.

STRUCTURE AND CONTENTS OF THE SALT VALLEY.

From obvious features in the topography of the borders of the Salt Valley, from the relations of the strata of the two opposite sides of the meadow to each other, and from the facts obtained in sundry deep salt wells or artesian borings made at several points

within the plain, it is pretty clear what the geological structure of this basin is, and what the distribution of the more important materials which it contains.

It is certain that the Valley owes its materials and its form to the same great dislocation or longitudinal Fault in the strata and to its branches, to which I have already attributed the peculiarities of the topography. Indeed it is evidently but one of a succession of great oval gulfs or deep basins, hollowed out along the line of this stupendous fracture, where the strata have been most shattered and most easily scooped by the rushing and eddying of the waters which have swept over the district, at the time of the rupturing of the rocks. The greater depth of the excavation at certain spots, like this one, along the extended course of the fissure, has arisen apparently from the presence of cross Faults intersecting or branching from the main one, their effect being to enlarge locally the crushed places, and to give the eroding waters a wider play and a greater power.

The earthy materials which fill the basin of the Preston Salt Works, are clays, sands, and scattered fragments much subdivided, of the limestone and slate rocks of the adjacent hills, all superficially covered by white sand, calcareous tufa, and brown peat. Whether these first named substances are stratified in an orderly manner, or for the most part confusedly intermingled together, there exist no sufficiently large and deep excavations to reveal it to us, but all analogy with like basin deposits would seem to imply that they are irregularly bedded. What their depth may be to the bottom of the basin, is a point equally undetermined; but from the fact, that borings of 200 and of 300 feet or more for salt water, and some of them near the margin of the meadow, have been made without penetrating to the solid rocks underneath, it is highly probable that they extend down a distance of many hundred feet. Whence these materials have been derived, is likewise a question of some uncertainty, though a careful examination of all the phenomena within and around the Valley leads to the conclusion that watery action, sudden and violent, and also long continued and gentle, have introduced them from the neighboring hills. One portion is no doubt the wreck of the shattered strata adjoining the dislocation, ground fine in the rush of the tumultuous currents which scooped out this basin and the chain of other valleys lying along the Fault, and left there at the time of their subsidence. Other higher and later deposits have, some of them, proceeded, in all probability, from river action, for we can hardly escape the admission that the waters of the Holston Valley must, during some of the convulsions which disturbed this region and rocked its surface, have been backed from their main and more permanent channel into this lateral and adjoining trough, the elevation of which above the river, is, at present, by no means considerable. Still, another portion of the materials,

and among them the salt and gypsum, which, from their economical or commercial value, and their great abundance, are the objects of more especial interest in this description, has been derived, in part, at least, from a silent and long-continued subterranean drainage or infiltration from out of the substance of the adjacent rocky strata. I say in part, for I deem it highly probable that one share, and much the largest portion of, especially the salt, has been collected by a process of perennial solution and downward percolation and precipitation from the comminuted earthy materials within the basin, the wreck of the saliferous and gypsiferous rocks of the north-west side of the great fracture.

From the facts here presented of the magnitude and depth of this salt and plaster-bearing basin, and the views we have indicated of the probable source and origin of the materials, it is obvious that the quantity of these precious substances embraced within the valley must be well nigh, if not absolutely, inexhaustible.

As it is entirely to the concurrence of the two circumstances, first, the presence, of a great stratum or rock formation of shales, containing diffused chloride of sodium, or common sea salt, and sulphate of lime, or gypsum; and secondly, of a long and profound Fault or break in the earth's crust, exposing this deposit and the soil collected from it, to conditions especially favorable to filtration and concentration of these minerals, that they have been gathered here in such abundance, or, indeed, prevail at all, a somewhat more detailed description of the dislocation and its effects, seems necessary to a full understanding of their probable extent.

The total length of this enormous fracture of the rocky crust, along the general line of the drainage of the Holston is, judging from geological indications, not less than 100 miles;—but the peculiar conditions essential to the accumulation of the saline and gypseous ingredients of the adjacent strata, appear to be restricted to the defined length of some 15 or 16 miles near its north-eastern extremity. Along this section of the Fault there is a succession of detached solid deposits of the gypsum of various magnitudes, but except in the one widest basin on the line of the fissure, called the Preston Salt Valley, there is nowhere any rock salt or productive brine, either yet discovered, or, since the failure of repeated borings, believed to be discoverable. The obvious explanation of this restriction of the salt and gypsum to the eastern portion of the Fault, is to be found, I conceive, in the rare and fortunate coincidence of features of geological structure and of topography not elsewhere to be met with, or at least not to the same fruitful extent. It would seem that the essential geological condition is, that the richer saliferous and gypsiferous beds of the umbral or carboniferous limestone formation, which are indeed the only true salt and plaster-bearing rocks of the whole Appala-

chian series of this region of the United States, are here brought by the increased vertical displacement at the dislocation, in a crushed state, and uptilted position, along the very chink of the fissure. Co-operating with which state of matters, the amphitheatrical form of the hills, and the transverse fractures in the strata,—co-incident apparently with the ravines between the hills,—have promoted a copious and perpetual subterranean drainage, which has been equally essential to the result by transporting and collecting the particles of the salt and gypsum into the sides and lower parts of the basin. In the district of the salt valley, the vertical movement or heave of the rocks along the line of the fracture is excessively great, inasmuch as the strata on the south-eastern side of the fissure belong to the great auroral magnesian limestone, the lowest of the Appalachian limestones, equivalent to the Cambrian or lowest fossiliferous system of England, while those on the other or north-western, in immediate contact with them, are the saliferous and gypsiferous beds of our Appalachian umbral series, the near representatives in age of the European carboniferous limestone, and in original position of horizontal stratification removed by many thousand feet of interposed deposits from the older lower masses, into contact with which they have been forced by the heave along the fracture. From approximate measurements, which Prof. W. B. Rogers and myself have made of the strata in the vicinity of the Preston Salt Valley, we infer that the vertical displacement or upthrow at the Fault, lifting and inverting the older Auroral strata southeast of the fissure upon the newer umbral beds, northwest of it, amounts to not less than some 8000 feet. It is of consequence to bear in mind this amazing extent of movement in the vertical direction, as we must infer that the gulf or gulfs which must yawn along the line of the fracture, by virtue of its irregularities, are of a size commensurate with the scale of the dislocation and the energy of the force which produced it. The greater the depth and width of such a gap holding the crushed saliferous and gypsiferous materials, all exposed for ages to a filtering action from the surface of the plain and the slopes of the surrounding hills, the larger and richer, of course, must be the deposits of the introduced salt and gypsum. Of all the local basins, seated on the line of the fracture, receptacles of this subterranean drainage, the broad and beautiful trough of the Preston Salt Valley appears to be the only one where we find assembled, and in their full development, all the favoring physical conditions essential to the concentration of the particles of the salt and gypsum from the strata, on a scale sufficiently grand to furnish rich and profitable stores of salt and pure salt water in addition to those large collections of solid commercial gypsum, such as have been accumulated in some of the neighboring basins lying along the same great fissure.

OF THE SALT OF THE PRESTON SALT VALLEY.

The Salt Wells.—This basin may be likened to a vast deep sponge, or moistened mass of clays and earthy matters, soaked extensively with highly concentrated salt and gypseous water, and embedding large bodies of solid rock salt and gypsum. That such are its contents and their condition is abundantly proved by the several deep borings, or artesian wells sunk in quest of the salt water in different parts of the plain. Of these borings, five permanently productive ones exist near the south-western end of the valley, where it is much contracted in width. Their position is a little to the north of the middle of the plain, and probably not far from the line of the great dislocation, or the deepest part of the gulf between the solid strata. Of these five wells, seldom more than two are in use at one time, and the supply from even one of these, it is alleged, would be sufficient to meet the demands of the present manufacture of salt here, large as the scale of this is. The quantity of pure salt now produced, exceeds 300,000 bushels per annum, having steadily increased from a yield of 75,000 bushels, twenty-five or thirty years ago, when the market price of the material was one dollar per bushel, while now it is barely fifty cents.

From 200 to 210 feet, is the usual depth from the surface at which the strongest or richest salt water is first found, and this is the average depth of these wells. In sinking some of the borings, gypsum was generally reached within twenty feet of the surface, and this valuable material, more or less continuously solid or embedded with clay, extends to the depth in certain instances of 200 feet, until salt and salt water are met with. In other cases the rock-salt and brine are encountered sooner. In one deep boring near the locality of the wells, more than 300 feet of *rock-salt*, divided by a little clay, were passed through without tapping any brine or water at all.

The brine rises in the wells, the diameters of which are about four inches, to within some 45 feet of the surface, to which it is lifted by pumps into reservoirs. From these receptacles it is conducted through wooden logs, bored, and carefully fitted to the evaporating houses or Salt Works, so called. Some of these are in the vicinity of the wells, but the chief one is outside of the Salt Valley and near the margin of the river, for the sake of facilitating the shipment of the salt, and for the easier accumulation of fuel. There seems to have been no abatement for years in the flow of the salt water, nor in the proportion of salt which it contains, and from this fact, and from several others, as the occurrence of the brine in various parts of the basin remote from these wells, and especially the now ascertained existence of vast depths of rock-salt, the capacity of supply may be regarded as altogether without limit.

Strength and purity of the Brine.—This salt water of the Preston basin is not only richer in salt, but freer from impurities or extraneous ingredients than any brine, the composition of which has been ascertained in the United States. The usual proportion of salt in it, is about 23 per cent., eighteen gallons yielding one bushel of pure salt. Neither the Kanawha, Muskingum, Kiskiminitas, nor Syracuse salines afford waters that approach this degree of concentration. Those of the three first-named districts, do not exhibit, except in rare and limited instances, a richness in salt exceeding some 10 per cent., while the waters of the latter locality have a strength ranging, we believe, from 12 to 17 per cent.

In proof of the pre-eminent purity of the brine of the Holston Salt Valley, compared with that of the other important salt waters of the country, it is merely necessary to cite the fact of its entire exemption from the chlorides of calcium and magnesium. As a consequence of the fortunate absence of these very common and inconvenient extraneous substances, this water forms, when evaporated, no appreciable amount of the usual *bittern*, which produces such a tendency to deliquescence or absorption of moisture, such as belongs to the salt made from brine contaminated with the chlorides above named. The only foreign ingredient present in any notable quantity in this water is sulphate of lime, or gypsum, but the very feeble solubility of this substance causes it to be wholly separated from the salt, in the process of evaporation. As, moreover, this brine is entirely pure from the presence of the oxide of iron, and every other coloring matter common in salt waters, the salt which it affords is remarkable for its snowy whiteness, and for that peculiar pearly lustre which distinguishes all chemically pure salt in its perfectly crystalline condition.

One important advantage arising from this absence of the ordinary impurities, is an unusual economy and facility in the separation of the salt, since this is obtained directly by simple evaporation, without any expensive preliminary process for removing the foreign ingredients; and there being moreover no accumulation of bittern, the evaporation is continued until nearly all the salt is abstracted from the water.

OF THE GYPSUM, OR PLASTER OF PARIS.

It has been already intimated that, accompanying the Great Fault of the north fork of the Holston, are large deposits of gypsum, and that these, like the salt, are restricted to that portion of the line of dislocation, some sixteen miles in length, where the saliferous and gypsiferous strata of the umbral or middle carboniferous series, form one side of the fissure, and have been for countless ages exposed to the percolation of the surface waters. These beds of plaster observe with the Fault a nearly straight

course from the neighborhood of the Salt Wells to Buchanan's, a distance of at least sixteen miles. They occur very generally on the margin of some basin or small level plain, among the hills, or else within or opposite the mouth of some ravine opening into one of these, and would appear to be in all cases in proximity either with the main Fault, or with some lateral or intersecting branch of it, or with a basin of crushed gypsiferous earth, or near some steep hill-side, where the rains and trickling water, acting for ages on the uptilted and shattered beds of gypseous shale and limestone, have dissolved out, carried down and collected into masses, the diffused particles of the sulphate of lime.

This view of the origin of the beds of plaster by filtration and concretion at some ancient epoch, is suggested by the positions of the several principal deposits opened or explored within the Preston Salt Valley.

The main bed, at present mined or quarried on the estate, is situated in a recess in the hills, or just at the mouth of a ravine on the north-west side of the valley, about three fourths of a mile north-east of the Salt Wells. It has been proved by auger-borings and by quarryings, to spread itself immediately beneath the surface over a breadth along the base of the hill of about four hundred feet, and out into or towards the valley a distance of nearly six hundred feet; and as the instrument employed for boring was an auger only ten feet in length, it is very probable that the mass extends much further forward, though constantly deepening, underneath the plain. At the quarry, which is at the very margin of the valley at the outlet of the ravine, the greatest depth penetrated has been sixty-six feet, but this does not reach the bottom. This quarry has a length of one hundred feet, following the base of the hill, and a width north and south of about forty feet. Here the gypsum and the gypseous limestone, from which, in part, it has been derived, are seen in immediate contact. The stratification, or grain rather, of the gypsum, for a true stratification it can hardly be termed, is nearly perpendicular. Immediately against the limestone wall of the quarry and of the valley, lies the purest portion of the gypsum opened. This is from twenty to twenty-five feet thick. Adjoining it on the south-east, is a perpendicular layer some four feet thick, of gypseous earth and impure dirty plaster, not extending the whole length of the quarry, but reaching to the bottom of it, forty or fifty feet, where it is developed. On the south-east of this "dirt bed" again, lies a very compact variety of the gypsum, nearly as rich in sulphate of lime as the best, but from its less suitableness for grinding, called "bad plaster."

If the plaster underlies the surface as extensively around the margin of the present quarry as we are entitled to infer from the results of the borings made there, and is of standard purity, we may safely estimate the capacity of this great deposit in mer-

chantable material within no more than sixty feet of the upper surface, rejecting one half of the bulk as unfit for market, at not less than 500,000 tons. But it is highly probable, nay, almost certain, that the bed is much deeper than sixty feet, since not one of the several masses quarried in this region of the Holston has ever been passed through,—while in one locality, some miles distant, a shaft was sunk into the gypsum a depth of six hundred feet. We have seen, too, that at the Salt Wells the gypsum is encountered at some points at twenty feet from the surface, and extends to the depth of two hundred feet in places where the rock-salt and brine are not sooner reached.

(To be continued.)

ART. V.—REMARKS ON THE PROCESS FOR SMELTING LEAD.—By ALEX. TRIPPEL, METALLURGICAL CHEMIST.

ALL lead ores used for practical purposes are divided by mineralogists into sulphurets and oxides, the former being like galena Jamesonis and bouronite (a sulphuret of lead, copper and antimony), the latter carbonate and phosphate of lead. The practical metallurgist, however, looks at them on different principles. The object of his examination is to see by what process the ore may be treated to the best advantage, as this point is quite important with reference to good results, and its determination depends on the quantity and quality of the gangue and the strange metals which accompany the ore. According to all these circumstances he will smelt it either in reverberatory or blast furnaces. It is, perhaps, of some interest, to make a brief description of all the different smelting processes, and especially of the chemical principles upon which they are founded.

A. SMELTING IN THE REVERBERATORY FURNACE.

The various methods of smelting lead ores in plain furnaces which, in the course of time, have been adopted and improved, are all based upon the fact that sulphuret of lead (galena, free from all earthy and strange metallic substances), calcined to a certain degree, is decomposed and forms subsulphuret, sulphate and oxide of lead, leaving one part of the mineral in its natural state. We have consequently four factors which, when acting under favorable circumstances upon each other, produce at last metallic lead. According to the temperature in the furnace, and the time allowed to the calcining, the proportions of these four substances, and consequently the chemical actions will vary; and here the three processes, commonly called the German, the English, and the French, differ from each other.

1. GERMAN SMELTING.

Galena calcined by means of a very slowly rising temperature will reach a point, where it is decomposed into one atom of sulphate and one atom of sulphuret. By reciprocal acting, supported by appropriate management, they will produce metallic lead and sulphureous acid.

$$PbO, SO^3 + PbS = PbO + 2SO^2.$$

During this first period of the process the charge has to be moved constantly, in order to expose all the particles to the air, and bring them in close contact with each other, while the fluid metal is sweating out and runs down the groove of the inclined bottom, in the melting pot. By raising the heat gradually, the calcining becomes more advanced, the quantity of sulphate increased, until three atoms of it comes to one of galena, when they are decomposed, and form oxide of lead and sulphureous acid.

$$3PbO, SO^3 + PbS = 4PbO + 4SO^2.$$

At this point begins the second period (pressen), the charge is mixed with coals and the oxide reduced into metal. The result of this method depends, besides the purity of the ore, on its able management; it requires an exact knowledge of the nature and fusibility of the mineral, and the quality of the furnace, also small, easily manageable charges. The gangue ought not to exceed a few per cent., and should be almost free from quartz. In consequence of these requirements, this process can only be of some use where the galena is found in calcareous rocks, and dressed very pure. The lead produced, however, is of great purity, and the expenses and losses are small.

2. ENGLISH SMELTING.

Galena calcined by a quickly rising temperature, forms, compared with the undecomposed galena, but little sulphate and oxide of lead. At a certain moment of imperfect calcination of the charge, when exposed to a strong heat, the different parts will act upon each other so as to produce some metal, subsulphuret and sulphureous acid.

$$PbO, SO^3 + 2PbS = Pb^2S + Pb + 2SO^2.$$

The subsulphuret of lead has the property, when cooling from the molten state to a pasty mass, to lose one part of lead, leaving behind a more hard-fusible sulphuret. In view of this circumstance the fire is increased, until the whole charge is molten, at which time the furnace doors are opened and air introduced, when the subsulphuret will cool, and consequently the lead will sweat out in drops. The furnaces are constructed according to the general rules for reverberatory furnaces, and with due regard

to the fuel intended to be used; they are rectangular, and have mostly four doors in the smelting-room for greater convenience in working, and a half globular hole (sumpf) in the bottom to receive the metal, which, at the end of the operation, is tapped into a melting-pot. The subsulphuret, after being treated several times in the same way, loses the greatest part of its metal, and what remains is thrown out and saved, for a further working in Scotch furnaces. The ores for this process do not need to be so pure as those for the German process; quartz, however, should be rejected as much as possible, as trials have proved that ores with 5 per cent. quartz cannot be worked any more without considerable loss. Calcareous fluxes are sometimes necessary, but not very effectual; fluor-spar is far better, but rare to get. In general, the English method is far more productive than the first, and gives a satisfactory result with regard to metal produced, as well as the quantity of coal used.

3. FRENCH SMELTING.

Galena, if calcined with a moderate fire for a long time, is decomposed and forms for the greater part sulphate and some oxide of lead. If the process is interrupted at a period when some galena is yet undecomposed, and the fire increased afterwards without melting the charge, the sulphate and sulphuret, by chemical affinity, will be changed into oxide of lead, which is reduced, together with perhaps superfluous sulphate, by means of coals. (*See German process*).

$$\text{Pb S}+3\text{Pb O, S O}^3=4\text{Pb O}+4\text{S O}^2.$$

This operation has been carried out successfully in Poullaouen, and lately on the Harz; it is very inferior to the English. It has, however, the advantage, that the ores are not required to be so pure as for the two former methods, and may especially be valuable where they carry a considerable quantity of blende and pyrites. The manipulation is as follows: The charge is divided through the four doors, so that $\frac{3}{4}$ comes near the fire bridge and the rest opposite. In about two hours a crust is formed, which shows the progress of calcining; it is broken, and worked under, while a new portion of the charge is exposed to the air and forms another crust. This operation, repeated for some time, will produce the quantity of sulphate required. Much depends on the ability of the attending smelter, to know the right moment. Too little sulphate forms subsulphuret (*see English process*), too much requires a waste of coals. For the next few hours the fire is kept very moderate, while the charge is translocated from the hotter to the cooler places, in order to have every part of it in the same condition. By this time, the sulphate has finished its action upon the galena, and produced oxide of lead, and the gangue has formed a light fusible slag with the oxides of iron,

etc. The last part of the operation which now follows, the reducing with coals, is continued for about 8 to 9 hours, during which the tap hole is filled with lead. The main difficulty is to have the necessary high temperature, without melting the whole charge; great attention is therefore recommended, especially at the period when the reducing begins. The wood or coals ought to be thrown on the charge by degrees, so as not to increase the heat more than is needed, and more fire be given only as the mass becomes dryer and poorer. The tapped lead is mostly covered with sulphuret and oxide; it is skimmed, and stirred with wood, which separates the strange matters and reduces the oxide. The whole process continues for sixteen hours, at the end of which, the remainder is thrown out and the furnace cleaned.

The difference of our three smelting methods lies, as it may be seen, mostly in the management of the fire, and requires, therefore, able and attentive workmen. It is indeed interesting to see how the same element acts so differently in the same process, producing subsulphuret or sulphate, oxidizing or reducing, with the aid of air or coals, according to the will of the manager. The furnace for this operation is similar to the English, and does not need any remarks.*

Many trials were made recently in the Harz, to smelt Harzer ores in reverberatoy furnaces; they are described in the "Huttenzeitung" by Director Kerl, a metallurgist of great reputation, and prove the incontestable fact, that no lead ores can be treated this way if they are not almost free from quartz, and carry but little of any other rock, pyrites, etc. Now we know well enough that dressing ores has a certain limit in every case, and cannot be continued beyond this, except with great losses, and in consequence the metallurgist sometimes may be forced to abandon these methods and use blast, where flam furnaces under other circumstances would be of far more simplicity and convenience.

B. SMELTING IN BLAST FURNACES.

The working of lead ores, which are either poor or mixed with copper, pyrites, antimonial, arsenical minerals, etc., is carried out in blast furnaces of various constructions, from the low Scotch, or so-called North American, to the 20 feet high furnace, according to the nature and size of the mineral. The chemical actions in the following processes are somewhat different from those already explained. We have seen before, that no reduction took place until a part of the charge was more or less oxidized, or at least desulphurized, which could be done only by air; but here we have no occasion to calcine the ore, except we do so before smelting it, in making two separate operations. We have, however,

* The furnaces mentioned in these remarks will be explained and drawn on an extra plate hereafter.

another way to disengage the lead from its sulphuret, based upon the fact that the metals, copper, iron, tin, zinc, lead, silver, antimony and arsenic, have not the same affinity to sulphur, but from the copper down to arsenic successively less, so that each metal of this line will desulphurize the sulphuret of the next following, and so much the more the further they lie from each other. These two points when applied practically, form the distinction between two smelting processes, one of which is called the precipitate work (Niederschlagsarbeit).

1. PRECIPITATE WORK.

Smelting Uncalcined Ore.—This operation is so called because the lead is, in fact, precipitated by means of another metal, which has stronger affinity to sulphur than lead, and this metal is broken or granulated pig iron. Although this method is comparatively expensive, and can be used only where iron is cheap, and lead at a reasonable price, no better one could be found for ores which are moderately rich, and where the gangue contains not too much sulphurets of zinc, antimony and arsenic, as they would be desulphurized by the iron, and so not only consume an unnecessarily great quantity of iron, but be injurious to the lead, in carrying the antimony, etc., in it. As a substitute for iron, some metallurgists tried to use subsilicates of iron from the puddling processs, also lime, but with no general success, because the sulphuret of lime is not easily fusible, and great heat partly decomposes this salt again, and the silicates of iron, as they come from the ironworks, do not allow a proper and constant control of the composition of the charge. Both substances, however, may be useful, as far as they are applied to get a proper slag, which is, for the whole operation, of very great importance. At this place it may be allowed to me to make a few brief remarks on the nature of slags, a part of metallurgy to which comparatively little attention is paid by learned men. The slags are silicates of oxides of metals or earths, that is to say, chemical combinations between silicic acid and oxides as bases. For a long time they were considered irregular accidental compositions of refuse, until Berzelius discovered and explained the principles of chemical affinity, proving that the slags too are found most positive under the same law that rules all chemical reactions, and that the electro-negative bodies in the slag are represented by silicic and fluoric acid, while the electro-positive consist of protoxide of iron, copper, manganese, the oxides of aluminum, calcium, magnesium, barytum, etc. On some rare occasions, however, the alumina changes its position; it is one of those bodies, the nature of which is fluctuating between the acid and basis; it acts positive, when a superfluence of negative bodies are present, and negative when the positive are prevailing. In analyzing slags we will find, that the proportions between silica and bases, or ra-

ther between their respective quantities of oxygen varies, and accordingly we distinguish sub-singulo, bi- and tri-silicates.

The following will show the qualities of slags.

OXYGEN OF SILICIC AC.	OXYGEN OF BASIS.	
1+X 1)	1	*Subsilicates* very fusible, thin fluid, but quickly congeals, sp. gr. 4.20, hardness 7.25, metallic lustre chrysolite crystallization.
1	1	*Singulosilicates* moderately fusible, more tough when molten, slowly congealing, sp. gr. 3.93, hardness 7.75, half metallic half glass lustre.
2	1	*Bisilicates* hardly fusible, very tough in molten state, slowly congealing, sp. gr. 3.50, hardness 8.35, glass lustre.
3	1	*Trisilicates.* The same as before but more explicit.

The general character of silicates, as described above, has, however, some exceptions, as for instance, not every singulo-silicate is less fusible than the sub-silicate of, perhaps, another or even the same basis; this is the case especially with the earths. These exceptions have but little influence in the common practice; it is more important to know the successive fusibility of the like silicates with different bases, and also the effect of combinations of silicates with regard to their fusibility. I give here a few data which may throw some light upon this question; the most of them are from the distinguished metallurgists Plattner and Berthier.

Basis.	Subsilicate.	Singulosilicate.	Bisilicate.	Remarks.
Lime.	2150° cels.	2100° c.	2200° c.	The melting points
Magnesia.	2250	2200	——	are calculated, taking
Aluminia.	2450	2420	2400	the melting point of
Baryta.	2200	2100	2150	tin, 230°
perox. Iron.	hardly fusible.	——	——	copper, 1173°
protox. Iron.	1832	1950	2100	platina, 2534°
protox. Copper,	1900	2200	——	
ox. Lead.	950	1100	1150	
ox. Zinc.	not fusible.	——	——	
protox. Manganese	almost like pr. ox. iron.			
ox. Tin.	not fusible.			

The following table will show the relative fusibility of combinations.

Silicates of		
Baryta and Lime,	2100° cels.	subsilicate.
Baryta and Alumina,	2050	subsilicate.
Baryta and Magnesia,	2000	subsilicate.
Lime (2 Aeq.) Alumin (1 Aeq.)	1800	subsilicate.
Lime (1 Aeq.) Alumin (1 Aeq.)	1918	singulosilicate.
Lime (1 Aeq.) Alumin (2 Aeq.)	1950	singulosilicate.
Lime (1 Aeq.) Magnesia (1 Aeq.	2000	subsilicate.
Aluminia Magnesia (the latter renders the first non fusible).		
Zinc Lime (the latter making the first fusible).		
perox. Iron Alumina (the same).		
protox. Iron Magnesia (very fusible).		bisilicate.

From the above tables it will readily appear that if, 1st. Some silicates are combined together, the combination will generally be a great deal more fusible than either of the ingredients, and accordingly, an addition of slags already formed to a charge will have a good effect.

2d. That the silicates of protoxide of iron are the most fusible, and together with lime and alumina in proper quantity, will form an excellent slag.

3d. That the peroxide of iron produces silicates, which are only fusible by adding others, consequently its use should be avoided as far as possible.

4th. That the fusibility of the like silicates is in conformity with the strength of the basis.

This much respecting the chemical principles of the slags. Although I am not of opinion, that a slag, as *one body*, ought to have exact stochiometic proportions, or that the practical metallurgist ought to be anxious to find the causes of non-success only in this department; I believe that a look into the theory of the slags will promote metallurgical operations, in enabling the manager to judge with more confidence about the processes he is about to undertake, and to compose his charges with due regard to general and just principles.

In coming back to our lead-smelting process, I would remark, that precipitate work requires decidedly bisilicates, because the operation is cleaner, the danger of loosing lead in the slag is but little in the presence of iron, and the sulphuret has, in consequence of the slow congealing of the slag, ample opportunity to separate itself to avoid mechanical losses.

I give below a few analyses of lead slags from this operation.

Si''' : R.	Si, O^3	Ca O.	$Al^2 O^3$	Mg O.	Pb O.	Fe O.	
25,35 : 12,18	48,80	3.26	4,62	1,24	5,30	36,00	Bodeman.
28 : 11,71	53,90	5.60	4,40	1,30	4,20	32,00	"
1 : 1	34,82	11,72	9.77	1,21	12,31	24,61	Kast.
23 : 12	45,00	6,31	4,62	0,75	7,80	35,85	Rametsberg.
28 : 12	54,48	16,16	6,60	1,71	1,62	19,42	

We see in these analyses the views expressed above confirmed, and the slag cleaner as the silicate is higher.

However advantageous the method may be to smelt the galena uncalcined with metallic iron, yet there are some inconveniences worth mentioning. The product, besides metallic lead and slags, is a sulphuret (stein), so-called "mat," which is composed, not only of the sulphuret of iron, most of the copper, as well as some zinc and antimony of the charge, but of a considerable part of sulphureted lead and silver. The cause of it is, that sulphuret of iron acts here as an electro-positive body in the presence of the others, and is, consequently, inclined to unite with the electronegative acting sulphurets of lead, silver, &c. Now if even, by

means of a very high temperature in the blast furnace, this mat was produced poor in lead, it cannot be done so without regard to its contents in silver; therefore it is to be subjected to another, further process, which I will describe below.

The following analyses will show the nature of the "mat."

	Pb.	Fe.	Cu.		Zn.	Sb.	Ag.
Plattner.	21,81	37,20	12,94	7,76	0,09	19,64	——
Lampadius.	25,18	33,12	12,10	——	4,75	19,52	0,20
Bruel.	13,65	63,14	0,88	——	0,13	22,01	0,03
Bodeman.	8,26	58,00	0,90	——	2,40	31,38	0,02
	73,43	9,81	0,39	0,19	0,39	15,33	0,11

A process of great peculiarity is carried out in the so-called North American furnaces, much resembling the Scotch. Mr. Plattner, in a memorial to the society for natural science in Freyberg, explains his views about this process. He thinks that one part of sulphur from the galena, being more oxidizable in a low temperature than lead, absorbs oxygen from the blast, and volatilizes as sulphureous acid, while the galena is converted into subsulphuret. After the greater part of the sulphur is gone, some lead gets oxidized, whereupon the oxide acts upon the subsulphuret, and produces lead and sulphureous acid. In about 12 hours, 25 cwt. of ore can be smelted with a loss of 10 per cent., some of which may be regained in working the slags over again.

2. SMELTING CALCINED ORES.

The ores for this process are the poorest, and carry generally much antimonial or arsenical minerals. They are calcined in open heaps, and more successfully in roasting furnaces, heated with turf, coals, and recently with gas. The calcining itself, that is to say, the treatment of ores and metallurgical products in a high temperature, admitting the co operation of atmospheric air, is a very simple process, although the causes of more or less success are not yet explained in some cases. The object is chiefly the removal of sulphur, antimony and arsenic, and to fill the place of sulphur with oxygen: in one word to change sulphurets into oxides. The effects of heat and oxygen alone on different sulphurets are far from being the same, and depend on the nature of their radicals. Sulphurets of iron, copper, and manganese, for instance, are decomposed by degrees in their respective protoxides, sulphate and peroxides; the noble metals in sulphur or sulphureous acid and metal; antimony and arsenic in antimonicous and arsenicous acids; lead in nothing but sulphate. Yet there is another reaction performed in the roasting process: it is the mutual action of the more or less calcined products themselves. I have already described these reactions as far as it concerns our object, and need not to repeat them. Latterly great efforts have been made by able metallurgists to improve the calcining process, and experiments were made to introduce more powerful desul-

phurizing elements than atmosheric air, but with very doubtful success. That which has received most notice is the application of steam. If we compare the results of experiments made by Mr. Cumenge, and on the other hand by Mr. Regnault and Prof. Kerl, in Klausthal, we find them so contrary, that not much can be said, yet, as far as my own experiments may have some worth, I believe, that the application of steam will be of great value for antimonial and arsenical sulphurets, but scarcely for the common copper or leadwork. I seize with great pleasure this opportunity to compliment Mr. Lieber for the very able report of Dr. Holland's patent in your Mining Magazine, showing the progressive direct interference and the importance of chemistry in metallurgical operations. In calcining the lead ores or lead products, care has to be taken, that the heat is moderate and progressive from beginning to end, to avoid the baking of the mass; it also requires a comparatively long time to give them a fair chance for decomposition. The half or well calcined ores are treated now either in very low blast furnaces, called Scotch, or in half-high or high furnaces. The Scotch furnace forms a rectangular prism of 16 feet depth, 13 feet wideness, and 24 feet height. The process itself is based upon the same principles as the English; the reaction of sulphate on sulphuret. The manipulation is the following: As soon as the tunnel is filled with fuel and set on fire, some ore, better some remainder from the last operation, is charged, and when half melted, taken out by means of a fork, cleaned of slags, which a good smelter ought to know at once, and put in again, with a few shovels of half-calcined ore, while a piece of wood or coal is placed just before the blowpipe to divide the blast all around for a moment. This being done, the new charge is again taken out after a while, as a half melted lump, and the whole operation repeated for about 16 hours, when the furnace is cleaned. The resulting lead at this time is from 20–40 cwt. with rich slags.

The smelting in the half-high furnace is carried on in several places, especially where the ore is not too fine; the furnaces are from 3 to 5 feet high, 16 feet wide on the level of the tuyere, and 3 feet deep. The charge is composed strictly to form singulosilicate slags, and consequently mixed with the proper fluxes, especially subsilicates of iron; calcined mat, if on hand, is likewise very profitably added; care, however, has to be taken, not to make the slags too much *basic*, else the operation will be constantly interrupted, if not stopped by half melted masses. A singular remedy is applied in some works, where circumstances require it in order to smelt fine dressed ores in low furnaces, and it consists in increasing the fire during the last few hours of roasting so much, as to melt the mass, which is tapped to the floor and broken in pieces.

The treatment in high furnaces of from 14–16 feet in height, is preferred for ores in a very fine powdered state (schliege), be-

cause they have no chance for slipping through the fuel in the hearth, and hindering the operation, but on the contrary, come more in contact with the fluxes and coals, and are consequently better prepared, before being exposed to the melting zone. The fluxes are as in the last process, and the general additions to the charges in the two last operations are oxidized ores or products, bottoms, scoria and slags from former processes.

The previous remarks on lead smelting were made on the supposition, that the object was only to win the lead and silver out of more or less pure lead ores; I say the silver, because it is the almost constant associate of galena, and would make not the slightest difference in the working of the preceding processes as far as we have passed through them; sometimes, however, the metallurgist has to treat lead ores, which contain, besides silver, considerable copper, that has to be saved, such as bouronite, or some Fahlores. This case, of course, becomes more complicated. Now if these two or three metals could be separated at the first smelting, I would not mention it here, as belonging to the treatment of copper; but they are separated completely almost at the last point, and in the smelting products we see the lead and silver disappear slowly, leaving only very little in them, while copper is in the same degree concentrated. Without going into any details, I think it not amiss to give a general view in a few words.

The ores, after being mixed together to an average equal yield for a blast, are smelted either with metallic iron, as in the Harz, or partly calcined, as in Freyberg, with the necessary fluxes, and other proper additions. The results are as already shown, lead, mat, and poor slags. The mat contains a part of lead, all the copper and some silver as sulphurets (see analysis); it is calcined, the surphur removed, the iron oxidized,—partly as protoxide,—and molten again with fluxes, oxidized products, &c., in low blast furnaces (Krumofen). The results are again lead, which takes up a great part of silver and mat (Stein), poorer in iron, but richer in copper. The same operation is four times repeated (Durchstechen), and the last mat, having about 30–40 per cent. copper concentrated, is given to be worked for copper.

The reactions in the furnace are the following:—

1st. The protoxide of iron forms with the silica slag and combines with the silicates of earths.

2d. The peroxide is partly reduced to protoxide and goes in the slag, partly to metal, which precipitates lead.

3d. The oxidized lead of the products, &c., is reduced by coal, and takes up some silver.

4th. The sulphate of lead is first reduced to sulphuret, then decomposed by the iron of No. 2; metallic lead and sulphuret of iron, combined with the sulphuret of copper, is the product.

5th. The sulphuret of No. 3 (Stein) takes up some silver, but being pressed into the metal in the hearth, gives the most of it to the lead.

These five points, set up by the celebrated Winkler, are so convincing, that, I believe, further remarks about the theory of this combined process are utterly superfluous. I may only add here, as a mere curiosity, that in Freyberg f. i., 28 months are calculated to close an account of a full campaign, and not less than about 70 different products are the result of the combined silver-lead and copper work.

Before closing, I think it is not out of place to cite some of the principal rules for the work in blast furnaces, as so very much depends on the manipulation before the furnace, that the best composed charges, without being properly worked, are not worth any thing. It cannot be my intention to go into any details, as this would be a fruitless work and could hardly be explained on the paper. The metallurgist, no matter how learned he may be, will meet with great embarrassments if he has not experienced the practical working of the tools in his hands on the spot itself.

The furnace consists of three main parts. 1st. *The tunnel*, a perpendicular channel, reaching down to the hearth, and is enclosed by the back or tuyere wall, the front wall, and the two sides; the front and back wall are at their lower parts arched, in order to leave room in front for a changeable breast wall, and on the back for the tuyere and blowpipe. 2d. *The hearth*, a more or less prismatic room, or in some cases, only the inclined bottom (spur) for receiving the molten masses or leading them to, 3d. *The fore-hearth*, an almost square chamber of convenient height from the floor, framed with iron plates, and communicating directly with the hearth. The room formed by the frame is filled up with some slags, and especially with a mixture of clay and coal (Gestübbe), and provided on its surface with half globular openings, which serve to receive the molten charge from the hearth, and a slag-groove. The situation of the tuyere is of great importance; the base line for the fixing of its place is unchangeable, being the upper edge of the fore-hearth. A situation too high forces the settling of the charges before they are properly prepared, while a tuyere too low renders the smelting sluggish.

As soon as the furnace is properly heated, the blast is applied by degrees, and some slags are charged to form the so-called nose. The nose is a cylindric tube, formed of cooled slags on the moment they reach the cold blast, surrounding and lengthening the tuyere, and reaching on the hearth from 12–18 inches. The benefit of a well managed nose is considerable, as it does not only protect the tuyere and back wall against the vapors of sulphur and a too strong heat, but serves for directing the blast wherever it is required, and is especially useful in smelting fine ores (Schlierche), forcing them to go down more in the corners, and so to avoid mechanical losses. Now, there are two cases to be observed: the nose may become too long and remove the melting zone too much to the front; the cause of it is the improper pro-

portion between charge and fuel,—the remedy is a few charges of coal, or if not successful, the opening of the breast and reducing the nose; while on the other hand, its being too small, or the diminishing of it, is still more disagreeable, and is caused by too light charges and superfluous coal, so that the tuyere and sometimes the tuyere wall is destroyed. The nose is undoubtedly a necessary evil; trials to avoid it by constructing the furnaces like those for iron ores, have proved well, but are costly, and have been given up again.

The charging is done in such a manner as to bring the ore and fluxes down the back wall, and the coal, as much as possible, to the front. For the first few hours, it requires more fuel than the average proportion, and the tunnel head will flame strongly, but afterwards the heat is modified, and no flames ought to be seen coming out of the chimney. This circumstance is in strict connection with the management of the nose and requires proper attention. A very disagreeable appearance is the *raw-smelting* (Rohgang) t. i., when the charge, before it is molten, falls down in the hearth; it is commonly the effect of irregular charging, and causes considerable stopping of the operation. Increased coals, more slags for fluxes, and the application of mechanical remedies, will help to remove the embarrassment; if not, the opening of the breast wall will be necessary. The fore-hearth must be renewed frequently with "Gestübbe;" the furnace itself endures from 4–14 weeks. If the operation is nearly finished, a few charges of slags are thrown in, which dissolve a part of the masses, sticking on the walls and in the hearth; the breast is broken open and the rest of them removed while glowing. The resulting metal or mat which fills the taphole, is ladled out, or tapped in an extra pot, according to circumstance.

The treatment of lead ores, if carefully, and in all its details and new improvements, described, would fill too much space; the preceding remarks contain the main principles, which may be applied to the different processes, describing the limits within which they can be carried out. At another time I intend to make some remarks on the more complicated working of silver ores.

ART. VI.—A REPORT ON THE ECONOMIC VALUE OF THE SEMI-BITUMINOUS COAL OF THE CUMBERLAND COAL BASIN. *Embracing the present and future relations of the Coal Trade,—a Description of the Basin,—the Origin of the Coal Measure,—the Quantity of Coal per Acre,—Analysis of the Coal,—its combustion,—its Uses,—Mode and Cost of Mining,—Facilities for Transportation to Market—and sundry Tables for reference.*—BY ROBERT J. RANKIN.

THE writer has been repeatedly called on for some practical and condensed information respecting the Cumberland Coal Basin, and the reason assigned has been that all the reliable information

respecting this great basin, can only be found in scattered and detached fragments of reports and newspapers, running through a period of many years, and accessible to but few.

For the purpose of satisfying this demand for information, and in compliance with the request of the respected editor of this Magazine, this report is submitted, not as embracing all, or even half that might be written on the subject, nor as an original or new thing under the sun, but as the condensed results of researches among the best authorities, and of personal observations over the basin.

The returning confidence in our monetary affairs has stimulated the inquiries of capitalists for safe means of investment, and the position is every day assumed, among practical men, *that the certain and gradual development of our internal trade in the great staples of domestic life, particulary in fuel, afford the surest and safest sources* for profitable investment, especially of surplus capital.

The writer's views may not be popular with *the speculator*, but he trusts they may be fairly considered by practical men, because they are truthful and practical.

The economy of life is substantially comprised in three elements—food, clothing, and fuel. These constituent necessities have stimulated American capital and labor to a production generally adequate to all lawful demands except in the case of the element of fuel—the primary one of the three. This element weighs about three times as much as all the other necessaries of life, and as tonnage constitutes the business of navigation, so the transportation of this element must yield its quota of profit in a greater ratio than the other articles of life.

That Providence which creates a nation and sustains an individual, has planted our nation upon a soil which, perhaps, more than any other favored spot of earth, contains exhaustless resources of this primary element of life. An American naturally takes and makes the most of that which first comes to hand, and we have thus substantially used up the forests and timber accessible to our capital and labor. This consumption of the materials of the forest is increasing in a ratio far beyond the conception of those who have not examined the subject. The consumption of wood on railroads will give an approximate idea. It appears that on the 1st of January, 1853, there were in the United States

13,219	miles of rail road	finished.
12,928	"	progressing.
7,000	"	engineered.

Total, 33,147 miles, at a cost of $994,650,000.

Assuming these roads to be all finished and in operation, they would require, at the very moderate average of 200 cords per mile per annum, 6,629,400 cords, which, at $3 per cord, would

cost $19,888,200; the other incidental costs of handling, piling, sheds, interest, &c., would largely increase this amount.

The daily increase of this consumption of wood must soon enforce the imperative resort to coal or coke; and it is a matter of wonder that, with the expansion of the railroad system, so small a fraction of it has been applied *directly to the construction of coal roads for the transportation of coal*, or the development of the coal beds of our country.

It is a singular fact in the economy of Providence, that manufacturing and productive industry flourish most successfully in the cool and temperate zones; and in these very zones does the primary element of their vitality, coal, most profusely abound.

That providential economy has placed our coal beds just on the very centres of our future population, and while American sagacity has driven the iron horse to a thousand points for gathering up the *surface* ore, yet the real diamond—*the black diamond*—has elicited comparatively little attention, although it is to be the foundation of our national wealth, and will give to our lead, iron, copper, gold, and silver, their value, for without it their reduction cannot be made. In the language of Prof. Buckland—"*it rows, it pumps, it excavates, it carries, it draws, it lifts, it hammers, it spins, it weaves, it prints.*" It may be added, that it gives man empire over the elements, subdues the rugged asperity of our soils, unites and binds together the distant places of the earth—christianizes the wild man, and associates the noblest attributes of humanity in fulfilling the purposes of God in the objects of his creation.

The distribution of the coal beds of the United States in their present and future development, has a most important relation to the highest and best interests of our nation, and on which the true value of those interests will measurably depend. Coal is to be one of the staples of our national life, the pabulum on which our metals and manufacturing interests are to feed, by which our agricultural productions are to be exchanged, by which our commerce is to be sustained and expanded, and which, by its supply and demand, will yet *measure the value of our domestic and public credits.*

In its productive energies it will augment our population many fold, and already in England performs an amount of labor that would require three hundred millions of men to perform by hand labor, *and has laid the foundation of, and made, some of the largest fortunes of that realm.* It is the servant, coadjutor and companion of every art which ministers to man's comfort, and elevates him in the scale of social humanity.

The coal trade is destined in our country to have its distinct and positive characteristics among our great and industrial interests as much as cotton, the breadstuffs, shipping or banking.

It will have its customs—its common law—and its routine; with features as distinctly marked as the most specific trade of life. It will require capital, science, and practical wisdom, experience, energy, prudence and tact and sagacity as profound as any other of the great industrial branches of American enterprise. It will have its speculations, peculations, profits and losses always attendant upon any new enterprise in our country, where the imitative spirit is almost equal to the intuitive faculty. It is yet in its inceptive state, has not yet shaken off the aspiration of youth seeking riches without industry and labor.

Our American coals have been known in the neighborhood of their localities, more or less for three quarters of a century, while the anthracite was first used in Philadelphia in 1812. The first use of the bituminous coals at tide-water was in 1804. But notwithstanding the actual known deposit of the coal, it was not for many years made an object of internal commerce, and only about 1820 that it was fairly afloat before the public eye.

About a third of a century in age, the trade has yet to draw wisdom from experience, and although the growth of its early years has been unparalleled, yet the vigor and power of its youth affords no measurable indication of its future greatness—what it will be one half century hence may be told only by the eye that can measure the expansion of the American mind at that period. Even the limited experience we have already attained by the consumption of coal in our marine and manufacturing enterprises corroborates the axiomatic assertion of McCullough, that, "*no nation, however favorably situated in other respects, not plentifully supplied with this material, need hope to rival those that are* (so supplied), *in most branches of manufacturing industry.*"

It is now only 34 years since the first Pennsylvania anthracite coal was sent to tide-water, and then amounted to only 365 tons, and in ten years, viz., in 1830, it only equalled 174,734 tons. About 1830, attention was carefully directed to the great resources of bituminous coal in the Cumberland basin, or as it was for some years termed, the "Frosburgh Coal Basin," from the principal town in the basin. In 1832, 300,000 bushels, equivalent to 10,344 tons, were sent down the Potomac River; the means of transportation and access to the mines being very limited, and of this quantity very little of it descended lower than Harper's Ferry. The coal produced in Great Britain exceeds one ton for each inhabitant of the realm, say 34,000,000 of tons, and worth at the mines seventy-five millions of dollars—and it is confidently believed, that the annually augmenting demand for American coal will enforce additional facilities *specifically adapted* to its transportation to market, and that within ten years from this time the production of our American coals will exceed seventeen millions of tons per annum. The present channels for transportation have cost but about fifty millions of dollars (the whole

cost of our American railroad system—if [illegible] being —

[illegible] and its routine; with

cost of our American railroad system, if now finished, being 994,650,000 dollars). It may surprise many readers to learn that in 1853 the receipts from freights on the four great railroad lines exceeded the receipts from passengers, and that some of the heaviest freight receipts were from the heaviest articles—thus disproving some of the old and prevailing notions about railroad receipts and profits.

	PASSENGERS.	FREIGHTS.
New York and Erie, ...	1,372,272	2,459,743
New York Central, ...	2,677,316	1,828,830
Pennsylvania Central, ...	1,069,740	1,507,320
Baltimore and Ohio, ...	464,244	1,477,578
	$5,583,572	$7,273,471

The Delaware and Hudson Canal—the Pennsylvania Coal Company—the Lehigh Company—the Schuylkill Navigation Company—the Reading Railroad—the Scranton Company—and other Pennsylvania Roads, with their proposed enlarged facilities, will contribute about ten millions of the aggregate amount, leaving the balance of seventeen millions to come from the Cumberland district.

The production of the Cumberland district for the year 1854, has been 721,871 tons, and with the proposed enlarged facilities, should exceed one million in 1855.

For some years our American bituminous coals were not appreciated, and were measurably superseded by the prejudice in favor of English bituminous coals, in consequence of which the ratio of consumption during the early consecutive years of their production cannot now be accurately determined, the consumption being comparatively local. But some idea may be formed of the increase of the coal trade from the ratio of increase in the production of the anthracite coal. Taylor says that "the increased production was, in the first ten years, viz., from 1827 to 1837, 1735 per cent; in the second ten years, viz., from 1837 to 1847, 200 per cent, and in twenty years previous to 1848, 6,150 per cent.

The amount of Cumberland coal shipped from its basin from July 1, 1846, to July 1, 1853, amounted to 1,286,899 tons—and the percentage of increase was as follows:

From July 1,	1846,	to July 1,	1847,	000 per cent.
"	1847,	"	1848,	350 "
"	1848,	"	1849,	50 "
"	1849,	"	1850,	80 "
"	1850,	"	1851,	88 "
"	1851,	"	1852,	81 "
"	1852,	"	1853,	30 "
For the six months from July 1, 1853, to January 1, 1854, ...				15 per cent.
and from July 1, 1846, to Jan. 1, 1854, .				10,844 pr. ct.

The anthracite coal trade increased in twenty years, prior to 1848, 6,150 per cent.

The amount shipped from the whole Cumberland district in 1853, was—

By Baltimore and Ohio Rail Road,	376,220 tons.
By Ohio and Chesapeake Canal,	157,760 "
Total for the year,	533,980 "

Of which the canal carried about 29 per cent.

Very gross misrepresentations have been made to the public in regard to the productiveness of this Cumberland coal region. It appears to be the fate attendant upon the development of every new branch of American industry, to have its inceptive operations loaded with speculations of parties whose entire knowledge and belief in its merits are measured by its anticipated results in the stock market as a "*Fancy*," and the up and down distance to which the "bulls" and "bears" may toss it. Many of the reports of this region that have appeared during the last two or three years, have contained very exaggerated statements of the amount of coal in particular deposits, by adding together the aggregate of all the coal strata (and they are *very* numerous), and assuming their total as the measure of the actually productive capacity of the locality. It may, however, safely be asserted that there are but five or six really *profitably productive* veins without shaft mining, and any quantity of unproductive veins can add but little relative value to a given district, although they may add largely to the actual amount of coal on deposit. There is also much difference in the quality of the Cumberland coal. The productions of an apple orchard may be all apples, yet the varieties and qualities vary indefinitely. So with this coal district—the geological formation—the upheaval—pressure of superincumbent strata—veins of slate, and other causes not as yet scientifically explained, have varied the character and quality of this coal to an extent equal to one or two dollars per ton in the market, among those acquainted with the difference.

Although many reports have been made of this basin, yet it may be safely asserted that no thoroughly scientific instrumental and topographical survey has been made, none at least from which a truthful model could be constructed. It is true that the reports of the Messrs. Rogers, the Sillimans, Dr. Ducatell, Taylor, Featherstonaugh, Owens, and others, have been before the public for some years, and have been the sources from which all other reports have been eked out; yet the reports of these gentlemen were only reconnoissances; they were carefully made indeed, and are reliable as the opinions of the most learned and scientific men of our day, and the predictions of their scientific acumen have been wonderfully verified.

A true, systematic, and thoroughly scientific geognostic survey has yet to be made, which would require an expenditure of 20,000 or 30,000 dollars, and the labor of 18 months or two years to accomplish.

This Cumberland coal trade has furnished another exemplification of a leading characteristic of the American mind. Thousands and millions of dollars have been plunged into the basin, because it was known and believed that coal was there. That the coal would follow the gold was a foregone conclusion, and the natural result has ensued. From unscientific, injudicious, or speculative investment upon the most superficial explorations, enough money has been wasted to construct a thoroughly finished and complete coal-carrying railroad, from the mines to market. It is wonderful that the large companies, capitalists, and coal merchants have not yet found out the real capacity and construction of the basin, have not made such an exploration as generally precedes or accompanies similar investments in England and the Continent. The reconnoissances alluded to, have reflected the highest credit on the scientific men who made them, but they were crippled in their investigations by limited compensations, limited time, and the want of a co-operating, scientific corps. A true exploration involves not only a thorough geological and topographical survey, but the order, number, thickness, superposition and continuity of veins—their analytical composition and modification, by aggregation and contiguity—their upheavals, denudations and erosions—dikes, faults, and their causes and consequences—their dip, strikes, and bearings, and a multitude of other relations. These can only be obtained by soundings, borings, and drifting, and the whole investigation should be such, that a model or artificial basin can be made that would exhibit, at a glance, a graphic illustration of its whole internal and superficial construction.

Visitors to the schools of mines, polytechnic institutions, and cabinets of mining districts in Europe, will see such models, telling in a word, the whole story of an investment, in its inception, progress and results. If the leading parties interested in the Cumberland basin would raise a fund, payable in instalments, the writer (without compensation to himself) would collect a scientific corps, whose labors and results would return the cost many hundred-fold to the subscribers, besides adding a large contribution of valuable information to capitalists.

A glance at the great American coal fields presents two great areas or deposits—the basins embraced in Pennsylvania, Maryland and Virginia, and the great basins of the western slope of the Alleghanies—the valleys of the Ohio and the Mississippi Rivers.

There is a world of future wealth locked up in the great western basin, but our present attention is now only directed to the sources of *present wealth* locked up in the Maryland portion of the American coal district.

As yet the eastern slope of the great Alleghany coalfield has been approached only in two directions, to tide-water—by the transportation lines of Pennsylvania, including those of Lackawanna; and the Baltimore and Ohio railroad, and the Ohio and Chesapeake canal.

It is a singular fact, that with such immense resources of coal, the means of transporting it to a market always demanding it are so difficult. The question is daily asked, Why is not the supply of coal greater? why is not the constantly augmenting demand supplied? The answer is of easy solution—*want of capacity in the channels of transportation.* This obstacle is in process of removal so far as the Cumberland region is affected, and with the double track of the Baltimore and Ohio railroad, and the enlarged facilities of the canal, the supply may, ere long, nearly equal the demand. The reports of the chief engineer of the Chesapeake and Ohio canal, and of A. T. Weld, Esq., civil engineer at Mount Savage (annexed), will more fully explain the facilities of getting these coals to market.

Taylor, one of the ablest of our authors on coals, says, in 1848, that the Maryland division is one of the smallest of the Alleghany districts; yet as *its coal is probably the best in America*, there is no doubt but it will contribute a large quota of coal, and much iron to the Atlantic ports, by means of the railroads and canal now in full operation."

OF THE ORIGIN OF COAL.

The question is often asked, What is the origin of coal? Is it of mineral or vegetable origin? And how are such immense masses of vegetable matter to be accounted for? In offering a solution of the question, it is not intended to enter into a disquisition on dynamic geology, as the subject of this report relates to economic geology only, and as such addresses itself to the common sense of practical life.

The crust of the earth is composed of rocks which have a certain order of super-position associated with their constituent elements, crystallization, &c. The lowest of these rocks constitute the *primary* series, containing the granites, &c. This primary formation is immediately covered by the transition, which seldom contains the terrestrial or marine vegetable remains, most of the remains belonging to marine animals. Carbon, the constituent element of vegetable life, is seldom found in these rocks, but the next strata in the series, after an interval of over 2,000 feet above the marine vestiges, contains the remains of plants which have grown on dry land or marshes. Here we find the coal measures. These measures consist of strata of sandstone, shale, coal, iron-ore, carbonate of iron, limestone, fire clays, &c., and whatever may have been the geognostic influences that modified the lithological characters of the coal measures and their associated rocks, they

have been the same all over the world. The coal is stratified between the sandstone and the slate, and although the original position may have been horizontal, yet the beds are seldom found entirely so, being disturbed by upheavals, faults, dynamic perturbations and inclinations of the floors and roofs, and other causes.

In the present state of geological knowledge, the vegetable origin of coal must be assumed, and this assumption is not affected by the conceded unsafety of deducing generalizations from structural affinities. Professor Johnson, in his report to the British Association assumes this position, and says that "carbon, oxygen and hydrogen are the component parts of living vegetables, and the same elements compose coal, but in different proportions. In the decomposition of vegetable matter, there are two agents always at work, viz., atmospheric air and water, which resolve it into carbon, oxygen and hydrogen, forming, with one another, those combinations, carburetted hydrogen, carbonic acid, and water. Vegetable matter, consequently, in different states, showed different proportions of these elements. The quantity of carbon in all the different varieties of coals in Mr. Johnson's table, was taken as a constant quantity; and from lignite downwards, we see a progressive loss of hydrogen and oxygen, until in anthracite the carbon is the chief component. In the change from lignite to fossil wood, we find that carbonic acid is parted with; and this continues without variation, in all the kinds down to cannel coal. In mines of lignite and cannel coal we find only *carbonic acid* or choke damp; while in mines of coal lower in the scale we find in addition, carburetted hydrogen or fire damp," "the hydrogen diminishing in each variety as we approach anthracite. In conclusion, Professor Johnson asserted, that bituminous matter must be of vegetable origin, in fact, chemistry proved it. Distillation of vegetable matter in a gas work, or in the laboratory of a volcano, was the same process."

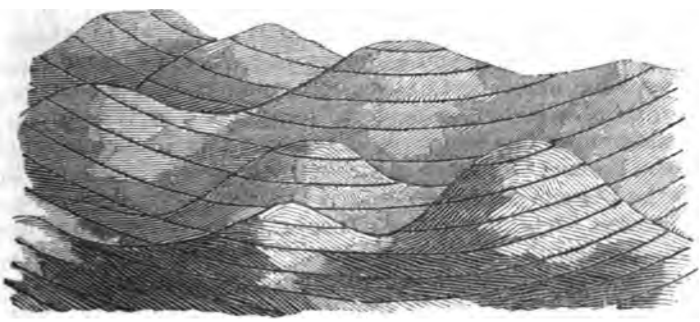
It is safe to assume that these vegetable productions grew in ancient marshes and fresh-water deposits, where might be seen the gigantic Sigillariæ, Calamites, Coniferæ, Stigmariæ, Cycadiæ, Annulariæ, Lepidodendra, and others, including 400 species, growing under the influence of the hot, humid, and climatic stimulants of a torrid zone, and indicating an exuberance of vegetable vitality, which has no resemblance at the present day. It has been suggested that they were carried to their present deposits by drifts, freshets, inundations, and those disturbances of the wafer system which seem congenital with the period of their formation, and then were brought under the detritus of adjacent degradations and there assumed their new state. It may be difficult to reconcile such conclusion with the present directions of isothermal and isochromenal lines, but it must be remembered that the coal measures and their associated series, mark a cataclysm, since which a grand climacteric has

elapsed, the solution of which is the study of the modern cosmogonist. The order of succession, however, and the relative ages of the different fossiliferous strata, present us with a chronometry of the highest interest. By this chronometry we ascend the stream of time, and simultaneously read the leaf-like strata of the book of geognostic history, and expose to view animal and vegetable organisms, the medallions of telluric life. All the presumptions of modern science are in favor of the theory that the coal plants are buried in the spot where they grew and flourished, as opposed to the theory of transportation by drifts of the primeval water system. The conclusions of the best observations favor the idea, that the great Alleghanian or Appalachian coal field, was the former basin of a great lake or water collection, which has been drained by the Mississippi, Susquehanna, and St. Lawrence, and the Hudson; as the head waters of the Alleghany, Genesee, Susquehanna, Chesapeake, St. Lawrence, take their rise within an area of five miles. The general inclination of the water shed of the whole coal district falls off and slopes towards the north, and the coal disappears beyond the Blossburgh deposit, and at the State line between Pennsylvania and New York the coal measures could only be found at an elevation of over 5000 feet. As the highest hills there are under 1000 feet above tidewater, the possibility of finding coal there or north of it, is impracticable.

CAUSE OF THE CURVATURES OF THE BASIN.

To a right comprehension of this coal basin, persons unacquainted with geology must imagine its orignal surface to have been a large plain or level, 20 miles long by 4 or 5 miles wide, and filled or made up of layers of coal, iron, limestone, fire clay, &c., like hot cakes on a heater, and in nearly parallel stratifications. Next imagine the surface of this plain on a level with the tops of the highest hills that now fill the basin. The next step is to picture to the mind's eye, the two mighty mountains on either side of this plain, Dan on the east, and Savage on the west—protruding their enormous and bulky masses through the earth's surface at the sides of this plain, rising slowly and solemnly, yet with invincible dynamic dignity to their present elevations, and carrying with them, attached to their sides like skirts, the outer edges and termini of these various strata, rising with and reposing on their sides and at their bases, without breaking the continuity of their stratification—and making their lines curved like a bow instead of level. The next process is to imagine this now cup or saucer-shaped plain eroded, cut out, shear down to the beds of the present streams by floods, whose water ways are now only designated by the lines of direction of the various rivers and streams that now intersect this whole region.

These floods have made clean work through coal, iron, limestone, clay, &c., even down through the old red sandstone, carrying away in their course enormous amounts of "*Big Vein*," leaving as memorials of their devastation the many hills, cones, pyramids and ridges that now occupy the basin (see illustrations, 1, 2). The observer must imagine these hills as so many cones made up of the original stratification, relatively, but their strata curved by the upheaval, and in looking for coal should bear in mind, that, owing to the rapid inclination or fall of George's Creek, and the several streams that make up the water system—the relative position of the Big Vein is affected, but its absolute position of continuity is always the same.* The fall or inclination of George's



Creek, from its rise in the water shed near Frostburg to its embouchure in the Potomac is about 1100 feet, and its line of inclination intersects or crosses the Big Vein on the property owned by the Aspinwall purchase, and of consequence renders this property or purchase one of the most valuable in the whole Cumberland region, because it is the only tract on George's Creek which can deliver its coal to the railroad, without any inclined plane. It is not believed that any other property on the Creek can dispense with an inclined plane, which, although comparatively inexpensive, yet in its first cost and annual depreciation, adds something to the cost of a ton of coal. Another fact of great value to this tract is, that for the above reasons the drainage of the mines follows the descent of the coal on the tram roads, which carry the coal downward from the mines to the railroad or cars for delivery at Baltimore or the canal.

DESCRIPTION OF THE CUMBERLAND COAL BASIN.

The formation of the Cumberland Coal Basin is unique. Shaped like a canoe, it stretches its length across the State of

* It is perhaps possible to account for the large amount of the Big Vein which has been found in Wall Street during the last two years, by supposing that at the time of the creation it was transported and deposited in Wall Street, for it is certain that the greater part of the Wall Street production has had no position or place in the Cumberland Basin within the memory of the oldest inhabitant.

Maryland in a north-easterly and south-westerly direction, one end projecting into Pennsylvania, and the other into Virginia. The purest and most valuable of its coal lying along the line of the keel of the canoe, intersected by its midship section. These lines intersect on the Aspinwall purchase.

The following description of it is taken from the report of Professor J. T. Ducatel, State Geologist of Maryland, made to the Governor and Legislature of that State.

This basin, he says, "one of the most interesting features in the physical geography of the country, as well as in its geology, is reached through the gap of Wills Mountain either by the Valley of Braddock Run, or by ascending Wills' Creek to where it receives Jenning's Run and following its ravine; or by the longer and more circuitous route along the Potomac, in the south-west foot of Dan Mountain around its termination to Westernport." The situation of this coal basin is between Dan Mountain to the east, and Savage Mountain to the west, extending within the limits of the State of Maryland twenty miles in length, and with an average breadth of four miles." There is a transverse ridge upon which Frosburgh stands, connecting the two mountains just named, dividing the basin into two unequal parts, and determining two distinct and opposite directions of drainage." "The depth of this basin* is computed at 1500 feet, and the lower strata, that have not yet been interfered with by the water courses, being continuous, probably *crop out towards both extremities at a considerable* elevation in these mountains. The surface of the basin is of course irregular, being intersected by deep ravines formed by the streams and rivers that traverse it."

"The great interest, in truth, connected with this coal basin, is its uncommon regularity; for as yet there is no reason to suspect the occurrence of any faults, or other serious dislocations of the strata.

"Jenning's Run, in the short distance of six miles in a direct line, cuts both longitudinally and transversely through the whole formation."

EXTRACTS FROM THE REPORT OF PROF. SILLIMAN.

"On the eastern confines of this coalfield is situated the town of Cumberland, famous in the wars of the English colonies with the French and Indians before the American Revolution. From this proximity arises the name of the Cumberland coalfield, by which name it is more generally known in other States. It is also called the Frostburg coalfield, from the village of this name, which

* *i. e.*, from its assumed original surface level before erosion by water.

stands in the midst of the coal region, and lastly, the *Alleghany coalfield*, from the county in which it is situated, and perhaps from some allusion to the high mountain ranges that form its boundaries.

"The elevation of the coalfield is generally estimated at 1,500 feet above tide-water, and 1,000 above Cumberland, whose distance from Frostburg is eleven miles.

"The geological structure of this coalfield is very simple and intelligible. Disregarding for the present, the hills which it contains, it must be viewed rather as a *trough*, than a *basin*. Its form has been compared to that of a canoe, and if we suppose the sides of the canoe to slant considerably, and the ends not to rise very abruptly, the comparison may be admitted as being accurate for illustration. If, however, we suppose several smaller canoes to be placed successively, one within the other, we shall then represent the successive strata of coal, shale or slate, sandstone, iron-ore, and limestone, of which this coal *trough* is composed. The three former of these strata, the coal, the shale, and the sandstone, are to be seen in almost every natural or artificial section of the country, while the iron-ore, and the limestone, although not universal, appear in many places, and in some situations form regular strata.

"This is the usual structure of coalfields, and as usual, the strata are repeated again and again, certainly (as appeared in the strata disclosed by the Potomac at Westernport on the south), at least eight or ten times, and as the bottom of the field has nowhere been seen, it is not improbable that the number of the coal measures may be still greater than has been observed.

"It follows necessarily from the structure of this coal country, that a cross section, in the direction of its shortest diameter, would present a series of cones parallel, not only in a horizontal, but in a vertical direction, each curve being in form not unlike a bow, with its convex portion downwards; the ends of the bow correspond with the highest lines, or outcroppings of the coal strata, and the lower part with the longitudinal axis of the trough. The upper edges of the coal strata present their outcroppings in the slopes, summits, or fronts of the two opposite mountain ranges, the Savage and the Dan, while the axis or line of lowest depression, called technically the synclinal axis, is found of necessity in that longitudinal hollow towards which the waters flow down the declivity of the opposite strata, producing the streams called Jenning's and Braddock Run, that flow northerly through valleys of the same name, and discharge their waters into Wills' Creek, which soon after becomes confluent with the Potomac at Cumberland; while in the opposite or southern direction flows George's Creek, passing by Lonaconing, and emptying also into the Potomac.

"Although it is certainly possible, that the rising of the mountain ranges that form the barriers of this coalfield, may have

lifted up the outer edges of this strata, it is also certain, that the interior structure has not been disturbed by uplifting forces from below. Hence the strata are not fractured, displaced, heaved, cut across by dikes or walls of intruded rocks, or even by fissures, remaining empty or filled with clay, sand, pebbles or larger masses. Such disturbances are of frequent occurrence in Europe, especially in Britain, and cause great trouble, perplexity and expense, in working the mines. The coal strata may, for example, be cut off abruptly by a dike or wall of rock, through which a passage must be made, perhaps with the risk of inundation, if the mine is on the lower side, and with no certainty of recovering the coal bed, for it may be heaved perhaps many yards or even several hundred feet from its proper place. Other strata may now abut upon the adit, and a painful, costly, and perhaps unsuccessful search must be made above or below for the lost coal. No troubles of this nature are to be encountered in the Frostburg coalfield, *for the strata of coal once opened, will not be interrupted* or fail until one arrive at their outcrop, in the regular ascent of the strata.

"The drainage of the mines is obviously of the highest importance to their successful exploration. In the case of a flat mining country, without valleys, there is no resource but to pump out the water by the steam engine; although it might, in some cases, be difficult to dispose of it upon the surface, but when the strata are elevated even in a small degree, and decline towards the valleys, especially when they decline also from opposite directions towards the same axis, or when different valleys decline towards a common outlet, then the situation is the best possible for drainage. Such is the fortunate condition of the Frostburg coalfield, at least as to all the strata that lie above the bottom of the valleys; and the coal that is in this situation* is so abundant that it will not be exhausted for centuries.

"The composition of the Frostburgh coal, as ascertained by several of our best chemists, in whom we may repose full confidence, presents on the average 78 to 80 per cent. of carbon, with 15 to 20 per cent. of bitumen and earthy matter, the latter being about 5 per cent. with only a trace of iron."

In confirmation of the opinion that this coal contains no appreciable quantity of sulphur, it is found that bar iron can be wrought by its aid, without imparting any brittleness to the iron, or in an degree injuring its malleability. It is a favorite fuel in the public armory at Harper's Ferry. †

(To be continued.)

* The Aspinwall purchase contains nearly four square miles of the Big Vein, having such facilities for drainage. The property of the Central Coal Mining Manufacturing Company contains about 800 acres of the Big Vein, with all the drainage sloping from the mines. Neither property require any expenditures for drainage, their water systems cannot be excelled.

† The Mount Savage Company use 75,000 tons of this coal per annum in the manufacture of their pig iron, and in the rolling mills.

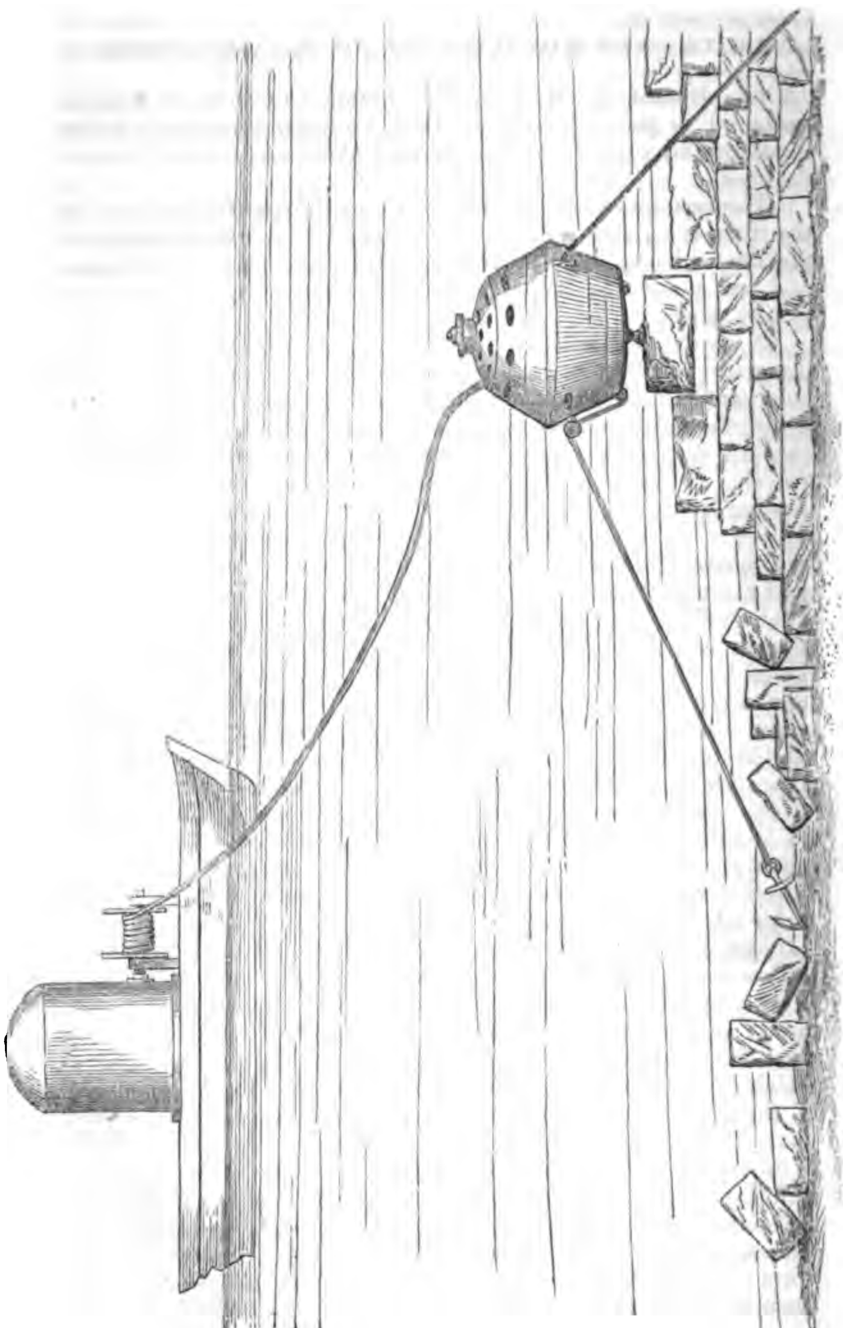
Art. VII.—NEW MACHINERY FOR RIVER EXPLORATIONS.

In all streams, where sufficient amounts of treasure may be gathered to pay for working their bottoms, obstacles, either of depth, rapidity of currents, or shifting sands, have baffled successful effort.

The new machinery of the Nautilus Submarine Co. now, for the first time, presented to the public, in its construction, and powers for locomotion under water, affords facilities for collection and transmission to the surface of any and every valuable, and at any depth.

A proper examination of the effects produced by streams traversing auriferous countries will show, that the mass of fine gold carried forward by the current will not be deposited on bars where the movement of water is most rapid, but will be carried forward into deep water, where decreased velocity, by action of gravity, will cause a deposit of the gold previously held in suspension by the water. Thus, the proper place to look for gold will be in the deep water below the bars, and where the current, by increased water way, is diminished. The vast amounts of gold abstracted from bars and river beds in California, indicate what would be the results obtained by applying this machinery in such localities. This opinion is sustained by the results obtained by Mr. Moffat, some two years since, who, with an ordinary diving-bell, brought up from about thirty feet depth, sand which washed full four dollars per pound of sand. As fast as sand is dug, it can be sent to the surface, and the whole bed of a river may be explored to discover the richest places of deposit.

So many difficulties were to be overcome, for successful working under water, that but little has heretofore been accomplished. To work successfully, it is necessary to have machinery so constructed as to be free from danger to the operator under all circumstances; to have the control of the machinery resident in himself; to be able to undertake all operations with the certainty, through resources at control, of success. After years of patient experimenting, the desired result has been obtained, of constructing a machine in such a manner as to obviate all difficulties hitherto met with. The only limit to the depth at which operations can be carried on, is offered by the capability of the human system to resist the action of a condensed atmosphere. Air gradually condensed, acting externally and internally in an equal degree, maintains the same equilibrium that exists at ordinary density; therefore no change of feeling is experienced. Reducing the density gradually, maintains the same equilibrium, and, consequently, the same negative effect. The use of reservoirs of condensed air, always at control of the operators, enables them to increase or diminish the density at will, and according to

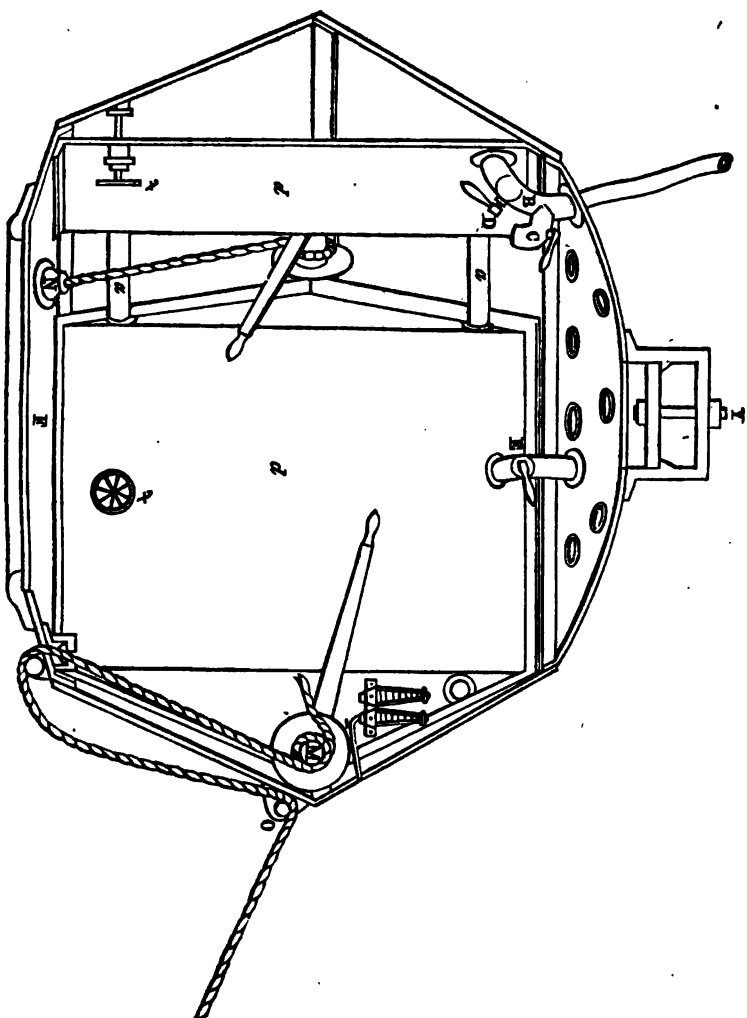


View of the Nautilus laying Sea Wall.

their sensations; for in one hundred and fifty feet of water, the pressure, if desired, may be reduced from that due to the depth to ordinary density at the surface.

The machinery floating at the surface, free from suspension, is entered at the top, and when closed is ready for descent, which is effected by simply touching a single valve.

During or after the descent is effected, the air necessary to equilibrize the pressure of water, is drawn from the reservoirs at the surface. After reaching the bottom the cover is removed, and free communication is held with the bed of the river or ocean.

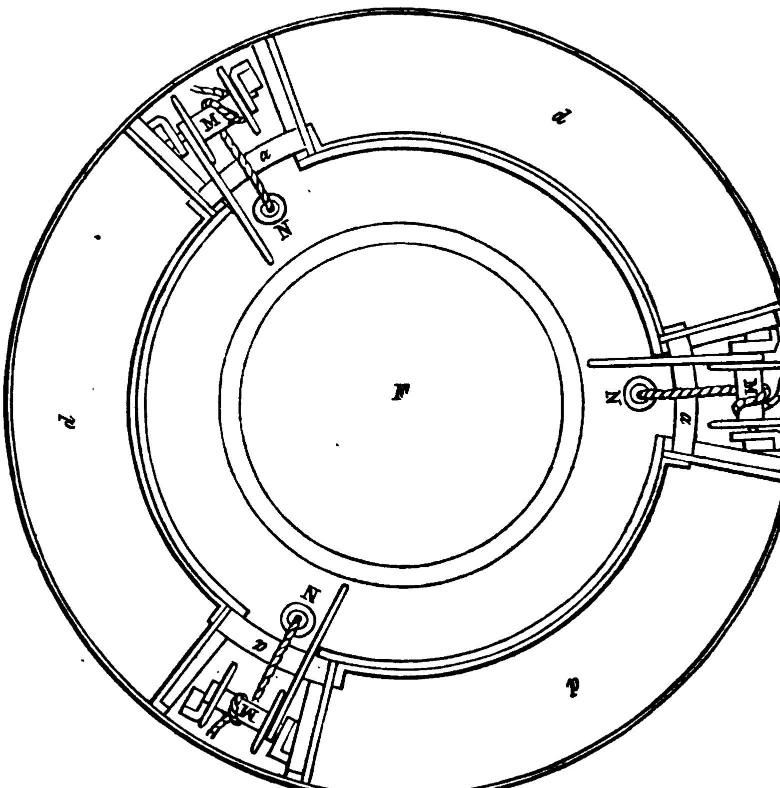


A Vertical Section.

Movement may be effected in any direction, either on or near the bottom. Objects gathered may be rapidly and uninterruptedly transmitted to the surface, by power resident in the machine itself. While submerged, all operations of whatever character may be carried on—blasting rocks, building walls or piers, securing wrecked property, gathering pearls, shells, coral, and sponges. To ascend, it is merely necessary to turn a single valve, and movement is commenced.

Rupturing or disconnecting the air-pipe causes no impediment to ascent, as five separate and distinct means exist of reaching the surface without the use of reservoirs. Presence of mind being exercised, no possibility of a serious accident can occur, as it has been the especial attempt to anticipate all possible conjectural ultra situations in which it could be placed, either through natural causes or by accident.

The "Nautilus" once in the water, may be towed from place to place. Reservoirs charged, attached to and floating with the



Horizontal Section.

Nautilus, may be worked away from the float containing the condensing apparatus: exhausted receivers being replaced by others replenished. In this way a number of machines may be operated in any locality, over a large area, using the same condensing power at a stationary point. This point comes more particularly into effect in pearl, coral, or sponge fisheries; or working the beds of auriferous rivers.

As regards the application of this machinery to practical work, the vast numbers of piers, breakwaters, walls, etc., under construction and to be constructed, open a field almost unlimited in its extent. By its use, stones of from five to ten tons may be handled and laid with extraordinary facility. The foundation being prepared, the stones are lowered, or thrown into the immediate vicinity in which they are required. Placing this machine over the stone, not more than two minutes are required to affix it, and the same time will suffice to suspend it at such distance from the bottom as to clear all obstacles. It can then be moved at the rate of ten feet per minute, towards its destined place, which can be assumed readily, as the machine can be moved in any direction. One minute will only be required to destroy its buoyancy, and deposit the stone; which, not occupying exactly the desired spot, may be caused to oscillate vertically until, by successive movements, it is properly placed. The only further operation being, to disconnect the suspending chains, and withdraw the "Lewis." The size of the stone, as regards the length of time required, is of no consequence, as it is no more trouble to affix to, or disconnect a large than a small stone. To suspend a large stone, a little longer time is necessary—say two minutes for every five tons. The advantages obtained by this method are, that the masons control all movements themselves, without reference to the surface; they know the direction in which they are required to move; they see where they are moving; they can raise or lower themselves and the stone instantaneously. The place of deposit being reached, by successive movements they can cause it to be occupied without trouble or delay. If "cramps" or "dowels" are used, being within the machine, on the stone, they can be placed with the same readiness as at the surface. The facilities thus offered permit the heaviest stones to be placed in about one fourth the time they could be with the ordinary bell; with much more readiness than in coffer dams, because the power being so great, and acting directly and instantaneously, permits the operators to continue without pausing to communicate with those working the machinery by which suspension and movement are effected. Stone can thus be laid at about one fourth the price of that by other means, owing to the greater amount of work performed by same number of men in a given time. Work can be carried on where water is moderately clear, as well by night as by day, as lanterns capable of affording illumination suf-

ficient to read a newspaper through twenty feet of water and one inch glass, are used in connection with the machinery. Arrangements in connection also allow a continuous conversation, *viva voce*, to be carried on with the surface, so that whatever is desired to be communicated either way, may be, without the use of signals, telegraphs, or other means. A stone of particular size, tools, etc., if wanted, may thus be ordered without any delay. Walls carried up course by course, either solid, or hollow filled with concrete, may, by the use of this machinery, be carried up in a single season, which would otherwise require three or four. The number of men required to work a machine handling stones of largest class, say seven to eight tons each, would be four at a time, or eight men as a gang. One engineer at the surface, to work the engine and hold communication with the operators. The cost of running an engine to supply three machines would not be over five dollars per day. In sea-way, a great advantage is, that on the approach of a storm, in a very short time the whole apparatus can be placed in a situation of safety, leaving nothing exposed. Its advantages over coffer dams are, that the first heavy cost is obviated; subsequent pumpings to obviate effects from leakage, or results of muddy or sandy foundations; the danger in rivers of being carried away by freshets or storms; the delays from leakages, and, lastly, the removing the dam after the work is completed. These numerous difficulties have heretofore prevented the construction of many works, now perfectly practicable. The machines, if properly cared for, are good for fifty years, with an occasional outlay for replacing valves, etc., which cannot exceed five per cent. of cost, annually.

The pearl fisheries are susceptible, through the medium of this machinery, of being worked most advantageously, and to a very great extent. All operations in this enterprise have heretofore been carried on by means of native divers. All machinery has heretofore failed, owing to difficulties inherent in itself. The self-suspending, free movement of the machinery, independent of connection with a vessel at the surface, has been wanting. It is a well-known fact, that in various localities, millions of acres are overlaid with pearl oysters. The shell, as soon as opened, is in the proper state for commerce. The deeper the water, the larger the shell; hence, going beyond the reach of ordinary diving, the shells will be found larger, finer, and of course more valuable than heretofore. The amount that can be gathered daily, will be from three to five tons each machine. The prices now ruling in Europe, vary from \$150 to \$720 per ton. All pearls which may be gathered, need not be taken into consideration in estimates of working, as no accurate estimate of quantity or value can be entered into; they are frequently now met with worth from three to seven thousand dollars in value. The proper and richest localities having been selected, the work should go on uninterrupt-

edly. An increased demand has been manifested for the last several years—so much so, that the demand has not, nor could be supplied, even at the high prices that have ruled for the last two or three years. It is confidently asserted that no branch of commerce can be rendered so lucrative as this, by the use of the "Nautilus" machines. The supply is not limited to any one spot, but is existent in almost every tropical sea.

It is a well-known fact, that immense treasures have been lost from time to time, the locality of which is well defined, as well as the amounts on board various vessels at the time of loss. Few, if any of these amounts have ever been obtained, owing to want of machinery proper for the purpose. These machines offer the means of reaching these treasures; for it is but necessary to descend on the vessels, and by the judicious application of powder, blow up, and remove such portions as may be necessary to reach the deposit of such treasure.

In connection with this machinery, is also an arrangement for placing telegraph wires securely beneath the beds of rivers, at a depth beyond the reach of anchors or other disturbing causes. The value of this is apparent; when it is known that the Magnetic Telegraph Co. in order to cross Jersey City, have to carry their wires ten miles up the river, then across on masts, then down again to Jersey City; one mile of wire would thus take the place of twenty, and be free from any derangement. So many localities exist where it is important to cross navigable streams, on anchorage ground, that the value of this result can be easily calculated.

For blasting rocks, in removing obstructions to navigation, possessing the power to first make examinations, see the most advantageous points for placing charges, drill the holes, charge them in series, and explode by galvanic currents, gives the whole effect of the explosion without loss; then remove the debris at the same time.

In making the soundings for blasting pot-rock at Hurl Gate, the talented officer in charge (Lieut. Balch) reported, that great difficulty was experienced in obtaining such soundings, owing to the current only permitting such soundings to be continued for a half-hour at a time. This machinery, resisting the action of currents, would have permitted a thorough examination to have been made, and then blasts to have been introduced, securing the full effect of the powder; whereas, by Maillefert's process, not more than twenty per cent. of charge was effective. In sea-way, also, as soon as under water its motion is of no effect. Works can thus be effected at greatly reduced cost, with the certainty of success in an estimated time.

The finer qualities of sponges, an important article in commerce, are now obtained solely by native divers. The finest classes grow in deep water. One machine in this occupation will do more than a hundred divers.

Corals, also, of finest quality, bring prices as high as from three to five guineas per ounce; they lie in depths attainable by machinery, but not by divers. The present means of obtaining them is rude and primitive. A glance at the number of ornaments made from this article will show what can be attained by its thorough prosecution.

Enough has been said on particular points. Generally, any operation, of whatever character, can be carried on under water. One more reference only. Camels, or bags properly made and inflated with air, possess the capability of raising the heaviest burdens. The pumps generate in reservoirs, when required, ten thousand cubic feet of air per hour, or a quantity sufficient to raise a two thousand ton ship loaded in two hours. Camels, properly constructed, will sustain any required pressure, and can be easily affixed to the timbers of a vessel for the purpose of raising her. The perfection of this machinery for all submarine purposes has been fully tested; and, in conclusion it may be added, is of entirely different construction in principle and adaptability from any other known machine ever devised in any country.

COMMERCIAL ASPECT OF THE MINING INTEREST.

NEW YORK, *January* 29, 1855.

There has been no revival of activity in the market for mining stocks since our last report. The mining stocks have not at all responded to the renewal, now a widely felt fact, in the money market. Distrust exists too extensively. The number of bogus and mismanaged companies has been too great; and created disgust as well as distrust. Yet the extent of undeveloped mining wealth in the country is enormous. The steady progress of geological examination in the various States is daily revealing this; but mining companies have too generally followed a mere empirical and shallow examination than sound scientific research. Geological surveys, as well as lawyers' opinions, are too often obtainable to suit the views of speculators, for a professional fee, rather than to reveal a thorough knowledge which is only of service for the ultimate success of mining enterprise.

We observe that the products of our copper mines are beginning to be estimated in Europe. The house of Rothschild, jr., has been buying here Lake Superior copper, which has acquired repute abroad, both for France and England, and the shipping demand is consequently on the increase.

We do not hear of any declaration of dividends from the mining companies, excepting one or two old coal companies, such as the Reading. This company, however, has made a dividend in stock instead of cash, though it passed the usual dividend in July altogether. The dividend for the year is ten per cent. The company, however, still has a large floating debt, though it has been re-

duced from what it was in July materially. The business of the road is great; but the repairs for the year, and the high prices of labor and iron have swollen its expenses. This year the case will be different.

Labor as well as iron has fallen in value. The high price of labor even in the fall compelled many companies to stop working altogether. One in particular—the Silver Lead Mining Company of Middletown, Conn., we know—the mines of which would have been worked through the fall and winter, but for the laborers refusing to work at less than the extreme high wages which ruled in the summer. The proposition was put to them distinctly—continuance of work through the winter season at a reasonable reduction, or cessation of work. The laborers preferred the latter. This company can only be successful by the greatest economy.

The results at present obtained have not been in proportion to the outlay, or the honest expectations of the projectors. Yet the mines yield lead in considerable abundance, and wherever it can be worked at small expense, and the wages of labor form the heaviest portion, it can be made to be profitable. At present it has not paid expenses.

The trying circumstances of the winter, in which so many laborers find themselves unable to obtain work at all, will enable many companies to return to working their mines on the opening of spring, as work at reasonable rates will be sought by the laborers. This disposition has shown itself. Of the rich Tennessee copper mines situated in Duck Town, Polk County, Tennessee, the "Isabella" Company is the foremost. Since the month of August last, it has produced 987 tons of copper, which has been sent to the Baltimore market and sold. In future the company intend to send its products to Swansea in England. The president of the company, Mr. Lyman Gilbert, went to Liverpool in the Baltic steamer, on the 24th instant, in order to close the negotiations which have been so long pending with an English company of capitalists, for the purchase of a number of Tennessee mines, to which we alluded in a previous number. We learn that £100,000 sterling has been offered for the Isabella mine. This was, however, not originally intended in the list of mines for sale. Since our last publication a rich discovery of iron ore has been made on the property of the Cumberland Coal Company; and which will doubtless be found in the properties of the neighboring mines, as the strata of the whole district is of one uniform character. The company is having an analysis made of the ore, which will be submitted to the public. This discovery enhances greatly the value of the coal property in the Cumberland district. The stock of the Cumberland Coal Company has been well maintained in value during the past two months, and since the iron ore discovery has become buoyant. Its large profits and small debt, independent of the new feature, however, favor the market value of the stock in easy money times. It is one of those stocks which can always be turned into money at a pinch—a very valuable circumstance—and in contrast with the stocks of all other coal companies.

The old Parker Vein Coal Company has been obliged to sell its property, which had been placed in the power of assignees by the directors, who overissued the stock so enormously. The only valuable part of the property,

however, has been bought by a number of the stockholders of the old company, and been made the basis of a new company, under the title of the "American Coal Company" of Maryland, of which Moses Bramball, Esq., of Jersey City, and a member of the Senate of New Jersey, has been made the president. As Mr. Bramball is disengaged from business, he can devote his whole attention to the company's, except when the legislature is sitting at Trenton. The privilege of subscribing to the stock of the new company was extended to all bona fide holders of shares in the Parker Vein Company. More subscriptions were offered than were wanted, and a proportionate allotment had to be made. The nominal capital of the American Coal Company is $1,500,000 in $25 shares, numbering 60,000. The property cost $500,000 including a working capital of $50,000. This was subscribed for at $8.33⅓ per share.

The prospects of the company are considered good. At all events, the alacrity with which the holders of stock in the old Parker Vein Company subscribed to the stock in the American Coal Company, shows that they consider the prospects bright. The property has been bought low; and if the coal mines they possess are really valuable, must yield a good profit. The directors say that they hope to pay a dividend at the end of the year. They are already mining coal, and selling it in the neighborhood.

The Hampshire Iron and Coal Company of Virginia, has been brought into working order since our last number; and is regularly delivering coal to market. The company has issued the remainder of its stock, which has been readily taken by its friends, who are acquainted with its merits, at the regular subscription price.

The company is sending to tide-water, by the Baltimore and Ohio railroad, over 200 tons per day. During the past year and a half, it has been engaged diligently in building its planes and road; and also making every preparation for transacting a large business. The mouth of its mines is one mile from the Baltimore and Ohio railroad, and for most of this distance the power of gravitation carries the coal down, and its momentum drags the empty cars up to be refilled. A double track and planes connect the mines with the Baltimore and Ohio railroad, and are built in the most substantial and permanent manner, with the capacity of carrying as we are informed, 1,000 tons per day. The lands of this company hold the only part of the great vein of coal in the Cumberland region which is situated directly on the Baltimore and Ohio railroad. Besides the 2,000 acres of coal land at Piedmont which the company is now working, it owns 800 acres of the large vein on George's Creek, and also over 8,000 acres in Hardy County, Virginia, which is awaiting the completion of the Alexandria, London, and Hampshire railroad.

The shipping agents of the company at Baltimore are Messrs. Dobbin & Warfield, well known as large and extensive dealers in coal, and their agents for sale are Messrs. Audenried, Potts & Co., the largest dealers in coal in the States, having establishments in New York, Philadelphia, Boston, &c. The Baltimore and Ohio Railroad Company is bound by its Virginia charter to provide freight for all Virginia coal, an advantage enjoyed by this company as a Virginia company. Its coal is said to be remarkable for its purity and free-

dom from bone and slate, and is highly commended by those who have seen and used it. The Cumberland coal region yielded last year 688,000 tons. Six years ago it only gave 30,000 to market.

From the Rudesill gold and copper mine we have very flattering accounts. The last advices state that they are raising ore from a strong and reliable vein —worth $5 per bushel. The company intend commencing to separate the gold from the ore immediately. The reputation of the mine warrants sanguine expectations. $30,000 was taken from this mine in one month when formerly worked—and a fractional part of the same result will soon make it a dividend paying stock. We class the "Rudesill" among the good mines, and believe there are many, if properly managed, that will put a new era on the gold mining interests of North Carolina. Some of the ore from the Rudesill, separated on Bradford's separator, yielded 35 pennyweights to the ton.

We learn that the Aspinwall Company are about to bring forward their large tract in the Cumberland coal region. It embraces some of the best portions of the "big vein." It is under the able and judicious superintendence of Robert G. Rankin.

BOSTON MINING SHARE MARKET.

BOSTON, *January 20th*, 1855.

The year 1854 closes with a complete prostration of *Mining Interests*, so far at least, as the current market value of the various stocks is concerned, and in that point of view, the year past has been of a most disastrous nature. There is, however, at least one encouraging feature, in the fact that all the leading mines of Lake Superior have steadily progressed, notwithstanding the serious difficulties continually obstructing the path of progress, and now their position is eminently ahead of what it was a year since, and the true value of the mines is very much more clearly shown than at that time. It is true that a large number of the newer mines, which had been scarcely more than projected, were compelled to abandon further operations, in consequence of the severe financial troubles that spread over the whole country; but such mines as had been developed sufficiently to prove the value in them, have been worked with vigor, and the results will *tell* at the opening of navigation the ensuing spring, when most of the companies will have a good amount of copper ready for shipment. The amount of copper sent forward the past year will exceed that for 1853, but not to so great a degree as had been anticipated, owing to the interminable difficulties which always surround new enterprises, and render calculations in advance almost futile, however good the basis may appear at the time. This is more particularly true of such adventures as copper mining on the far distant shores of Lake Superior, where the facilities for operating are so completely under the control of circumstances, and the real base of operations so far distant from the actual point of carrying on the works. The almost total want of mechanical facilities at the mines is a most serious hindrance, frequently, to success; for as at present every thing used in executing the labor must be transported from Detroit, or other points below, and even the most trifling repairs of the machinery render the services of mechanics hundreds of miles distant necessary, to whom the work must be sent and

often, mining operations are very much retarded, and even in some cases entirely obstructed by such want of facilities among themselves. The establishment of a machine shop at the mines, for repairs at least, seems almost imperative, and we hope another season will not be allowed to pass away without such a most desirable improvement.

Without wishing to give undue encouragement to the hopes of those who have "braved the blast" of mining difficulties during the past year, and still hold their stocks "for better or worse," we cannot but express our decided opinion, that, although every thing has seemed disastrous in the highest degree heretofore, there certainly is an excellent basis for future hopes, and the year 1855 has an ample margin to improve upon, taking the results of 1854 for a basis. We have entire confidence in the success of the Lake Superior mines, and after the *Minnesota* and *Pittsburg*, which have already proved their value, we look for excellent success from the *Copper Falls*, *Forest*, *Isle Royale*, *National*, *North American*, *North Western*, *Portage*, *Rockland*, *Toltec*, and probably others which have as yet made little progress. We presume many have made up their minds that *Lake Superior Copper Mining* is retrograding, judging from the experience of the past, but we do not hesitate to say that *such a view of the matter is entirely at variance with the actual fact*, and so far as general success is concerned, the *mines* never promised better than at this moment. Recent advices from the different mining agents give the greatest encouragement to the managers of the various companies; and now that the monetary difficulties have, to a great degree, been overcome, the future will begin to brighten, instead of a continued overhanging of black and portentous clouds, which have so long darkened the financial sky, and rendered success in almost any enterprise requiring capital, a matter of the greatest uncertainty.

Of the stock market little can be said of interest to the general reader, but fortunately that little is in some degree of a favorable nature, when compared with the position of matters on the first of December. Since that time *Copper Falls* has advanced from 24 to 36, including the $6 assessment, which shows a *net* gain of $6 per share, even while money was in active demand at two per cent. a month on the best of securities. If such results could be attained under so adverse a state of things, what may not be looked for when money becomes more easy of access, and the mine developes its immense resources, as it is quite sure to do at an early day, under its present admirable management. No doubt those who sold their stock at $24 per share, were alarmed without cause, at the great depreciation of the market value of their property, and thus pressed it for sale from a fear that it might become even less valuable. This was their misfortune, however; and those who were wise enough to invest their surplus funds have already begun to reap the benefit, and will far more so yet, with firmness to hold their stock, and patience to wait for the ever revolving movements of time to bring about its inevitable results.

Toltec has improved to 3½ and is in good demand, notwithstanding the assessment of $1 per share due January 8. Many of the stockholders availed themselves of the five per cent. discount to those who paid their assessment

December 20, and consequently very little will have to be paid January 8. The managers are quite confident that no more assessments will be called for before spring, and as the stock is one of the cheapest of the low priced ones, it would not be surprising to see a marked improvement in it within a few months.

Isle Royale has been depressed, with sales as low as $8 per share, for $12 paid in, and at this point the stock is very cheap and a desirable purchase. The annual meeting of this company is to be held at Washington, D. C., January 15, when we hope the managers will make a full statement of the position and prospects of the company, which are generally considered to be most excellent. The rapid calling of assessments the past six months has, together with the general disastrous state of the market, caused a serious depreciation in the stock, although the policy of pushing forward the mining work is a most excellent one, and many are of the opinion that the *Isle Royale* will pay a dividend as soon as any of the mining companies which are at present non-productive. The stock is well held, by a class of men who are not compelled to part with their shares under every pressing temporary demand for money, but come forward and, generally speaking, promptly pay up their assessments, with entire confidence that the property will, in due time, most handsomely reward them for the present outlay.

Pittsburg is badly pressed for sale, from the almost certainty that none, or at best a very small dividend will be paid in February. Not however, that the mine fails to produce its usual amount of copper, but all the earnings having previously been paid out in dividends, the managers finding that they have no working capital, which is essentially necessary to the profitable operation of such a company, have wisely determined to reserve a sufficient amount for such a purpose, say $100,000, which is very nearly the *net* income for a year's product of copper. We do not presume that it will be deemed best to take the whole amount from *one* year's income, and thus pass dividends entirely, but perhaps half of it will be reserved from the dividends to be paid in 1855. The great error of this company has been a desire to pay too large an interest to the stockholders, so that they have divided every cent earned; but by a prudent policy, a working capital of more than $100,000 might have been already in hand, and the stockholders never have received less than $5 per share *semi-annually*, which would undoubtedly have perfectly satisfied them all, or those it would not don't deserve any thing.

Minnesota has been offered at $140 per share, and is now dull at $150, although it has been given out by those in authority that a dividend of $30 per share, the same as last year, may be expected, but not, perhaps, immediately, in consequence of the great difficulty of realizing cash on the copper in the present state of money matters. The product of the past season exceeds that of 1853, and the mine was never more prosperous than at the present time. This stock at $140 would be the same as *Pittsburg* (Cliff) at $70, the former having but 3,000 shares and the latter 6,000, which is an important consideration, when we remember that the same net income would give a dividend of *double* the amount *per share* on the former than the latter.

The annual meeting of the *Forest* Co. was held in this city December 11,

and the old board of officers unanimously re-elected, and the plan for raising money alluded to in our last was adopted.

BOSTON MINING SHARE LIST.

Fluctuations for December, 1854, *in thirty-one different Mining Stocks, sold at the Boston Stock and Exchange Board, showing their Highest and Lowest Points, and the Date, with the Market Value at the close of the Month, Gain or Loss for the Month, and number of Shares sold in each.*

MINING STOCKS, BOSTON.	Nominal Capital.	Shares.	Par.	Paid in Dec. 20.	Highest Sales.	Day Mon.	Lowest Sales.	Day Mon.	Value Dec. 30.	From Nov. 29. Gain.	From Nov. 29. Loss.	Shares sold in Dec.	Shares sold in Nov.
Adventure, *Copper*	$250,000	10,000	25	$8.50	—	—	—	—	1	—	½	No sale.	No sale.
Algomah	500,000	20,000	25	2.37½	—	—	—	—	1	—	½	No sale.	No sale.
Bay State	500,000	20,000	25	†2.00	—	—	—	—	—	—	½	No sale.	No sale.
Bohemian	250,000	16,666	15	4.94	—	—	—	—	½	—	½	No sale	No sale.
Boston	500,000	20,000	25	†2.00	—	—	—	—	—	—	½	No sale.	No sale.
Copper Falls	300,000	10,000	30	24.00	*34	27	24½	1	*34	4	—	237	643
Dana	500,000	20,000	25	1.62½	—	—	—	—	½	—	½	No sale.	No sale.
Forest	200,000	10,000	20	18.00	5	26	5	26	5	0	0	50	250
Fulton	500,000	100,000	5	†2 00	—	—	—	—	½	0	0	No sale.	No sale.
Glen	500,000	20,000	25	†2.00	—	—	—	—	½	0	0	No sale.	No sale.
Isle Royale	120,000	12,000	10	12.00	11	1	*8	26	8	—	2	150	200
Malone, *Sandstone*	400,000	40,000	10	3.12½	60	15	40	19	45	0	0	600	675
Manassas, *Mining*	1,000,000	100,000	10	†2.00	—	—	—	—	—	—	½	No sale.	No sale.
Manitou, *Copper*	500,000	20,000	25	0.75	—	—	—	—	½	0	0	No sale.	No sale.
Minnesota	300,000	3,000	100	22.00	—	—	—	—	140	—	27	No sale.	1
National	250,000	10,000	25	6.00	—	—	—	—	*12	—	5	No sale.	No sale.
Native	250,000	10,000	25	4.75	—	—	—	—	½	—	½	No sale.	No sale.
N. American	300,000	10,000	30	21.50	—	—	—	—	40	—	20	No sale.	No sale.
Norwich	100,000	20,000	5	†5.00	—	—	—	—	3½	—	½	No sale.	No sale.
North Western	300,000	9,000	33⅓	14.67	15	28	15	28	15	—	5	32	50
Phœnix	300,000	10,000	30	8.00	—	—	—	—	3½	—	½	No sale.	150
Pittsburg (*Cliff*)	....	6,000	—	18.50	118	7	118	7	115	—	5	5	41
Ridge	....	10,000	—	6.50	—	—	—	—	4½	—	1	No sale.	No sale.
Ripley	500,000	40,000	12½	2.75	½	20	½	20	½	—	½	100	50
Shawmut	500,000	20,000	25	3.00	—	—	—	—	½	0	0	No sale.	No sal .
Star	500,000	20,000	25	5.50	—	—	—	—	4	0	0	No sale.	No sal .
Summit	500,000	40,000	12½	†5.00	—	—	—	—	4	0	0	No sale.	No sal .
Toltec	500,000	20,000	25	8.00	3½	4	3	11	3½	—	½	640	961
Winthrop	500,000	20,000	25	1.25	½	19	½	23	½	0	0	230	100
Webster	200,000	40,000	5	†2.00	—	—	—	—	—	—	½	No sale.	No sale.
W. Castleton, *Slate*	1,000,000	50,000	20	†6.00	—	—	—	—	2	0	0	No sale.	No sale.

* Assessment paid. † These are fully paid stock, not assessable without a vote of the shareholders.
One dollar per share was paid into the *Isle Royale* Dec. 15, *National*, $2, Dec. 15, and *Copper Falls*, $6, per share Dec. 20, all of which are included above.

The entire property of the company is to be mortgaged for $150,000, one third of which is reserved subject to the future action of the stockholders, and the balance, $100,000, to be issued as follows. Each stockholder is to transfer to the company one fourth of his stock, and pay in $20 with cash. Share so transferred, receiving the company's note for an amount equal to the money paid in, and the value of the stock at $20 per share. The notes bear interest at 6 per cent., and are payable in two years, the holders having the right to take back the stock they had transferred to the company, at whatever rate the shares sold at, [say $5] January, 1855. Messrs. G. Winthrop Coffin, Thos. W. Pierce, and H. F. Durant were appointed trustees, under the mortgage, and

the notes are to be issued in sums from $40 to $100, in order to accommodate all the stockholders. This arrangement is thought to be an excellent one for the stockholders, and under the circumstances the best that could be done for the interests of the company. The mine is now looking well, and every thing is in complete order for the winter campaign, and as the entire force at the mine is to be employed in getting out copper instead of farther opening the mine, we look for good results in the shape of copper ready for shipment at the opening of navigation. There is hardly any question but that the mine will be carried through and yet come out profitable to the stockholders. The managers have met with the most obstinate difficulties all throughout, but they are determined to carry their work through, and yet pay dividends to the stockholders.

JOURNAL OF GOLD MINING OPERATIONS.

EXPORTS OF GOLD FROM CALIFORNIA.

The following is the amount of gold bullion exported to Europe and the Atlantic States, as exhibited by manifest at the Custom House, San Francisco, during the years 1853 and 1854:

1853.	1st Quarter,		$15,157,913 58
"	2d "		14,095,035 18
"	3d "		12,241,476 19
"	4th "		15,336,023 18
		Total—1853,	$56,830,448 93
1854.	1st Quarter,		$ 9,764,702 96
"	2d "		13,786,458 01
"	3d "		13,794,760 47
"	4th "		13,088,752 00
		Total—1854,	$50,434,873 44

Amount and value of quicksilver, the product of the State of California, shipped from San Francisco during the year 1854:

20,000 flasks, weighing 75 lbs. each, making 1,500,000 lbs. at fifty cents per lb. $750,000 00

MINING OPERATIONS.

The Governor, in his message to the Legislature of California, presents the following survey of mining operations for the year 1854.

Throughout the mining region, extending about six hundred miles in length —from the Four Creeks to the Oregon line—and averaging not less than forty-five miles in width, many highly important and useful improvements have been made, especially in the excavation and construction of canals and ditches of great length, designed to supply with water, at all seasons of the year, locations known as "dry diggings."

By means of these canals and ditches, water is conveyed from the principal rivers and distributed over vast districts of mining country, enabling thou-

sands of enterprising and industrious men diligently, and at all seasons of the year, to prosecute their labors, and to increase immensely the amount of gold annually obtained.

These improvements, now so indispensable to the rapid and complete development of our vast mineral resources, it is believed can, and, it is hoped, will be so managed in accordance with the local mining laws by those having control, as to render them alike efficient in advancing the interests of labor and yielding just returns to capital invested.

Heretofore, during the summer months, miners have been compelled to abandon valuable claims—in fact, whole districts of country—for the reason that sufficient water could not be obtained for mining purposes. But during the past year much has been done to overcome this great obstacle, and now, by means of canals and ditches, water—the necessary, in fact indispensable element in successful mining—is conveyed in abundance to the door of the miner, and it is confidently believed that in future a large portion of our mining population will be enabled to pursue their labors profitably to themselves, and to the increased prosperity of the State, throughout all seasons of the year. This is a *desideratum* properly appreciated by those of our citizens who have been compelled in former years, for want of water, to forsake the richest sections of the country.

From the increased facilities afforded by improvements in machinery, much advancement has also been made in obtaining gold embedded in quartz rock. Large and well constructed mills have been erected in various parts of the State, and immense quantities of the precious metal extracted from the numerous veins of auriferous quartz which penetrate the hills of California.

Improvements suggested by past experience in the implements used by the river, placer, and gulch miner, have greatly diminished the labor heretofore rendered necessary in separating the gold from sand and rock. Indeed, we have every reason to congratulate ourselves on the many and varied improvements in all departments of mining operations, facilitating as they do the extraction of gold, developing the inexhaustible mineral resources of the State, and opening an enlarged field to the industry and enterprise of our citizens, as well as adding vastly to the already unparalleled wealth of California.

From a portion of the mining counties I have been enabled to obtain information in relation to investments made in canals, ditches, and quartz machinery, as follows:

OPERATIONS IN QUARTZ.

Counties.	No. of Companies.	Capital.	Expenses.	Receipts.
Nevada,	5	$700,000	$299,870	$716,000 00
Shasta,	1	27,000	19,200	53,000 00
El Dorado,	5	140,000	119,892	490,000 00
Amador,	6	140,000	213,166	412,000 00
Total,	18	$1,007,000	$652,128	$1,671,000 00

These eighteen companies have been in successful operation during the past year, and the above figures, obtained upon careful inquiry, may be regarded as nearly correct.

It is proper her also to state that fourteen other companies, four in Siskiyou and Klamath, two in Nevada, one in Sierra, two in Placer, one in Tuolumne, and four in Mariposa, have also been in successful operation, and doing quite as well during the past year as the eighteen above referred to, but as no returns have been received from them they are not included in the above.

It is also known that during the latter part of the year sixteen other companies commenced operations in the following named counties, and with capital stock as below stated.

	No. of Companies.	Capital Stock.
Placer,	1	$ 22,000 00
Nevada,	6	104,000 00
El Dorado,	4	46,000 00
Amador,	3	18,000 00
Tuolumne,	2	50,000 00
Total,	16	$240,000 00

These new companies, it is understood, all commence operations with very flattering prospects of success.

CANALS AND DITCHES.

	No. of Miles.	Value.
El Dorado,	173	$380,000 00
Calaveras,	180	369,000 00
Tuolumne,	185	400,000 00
Amador,	129	298,000 00
Placer,	160	330,000 00
Nevada,	208	400,000 00
Sierra,	129	117,000 00
Total,	1,164	$2,294,000 00

In addition to the above, in the same counties, and in others, there is quite a number of canals and ditches, which, within a few months will be in actual use, contributing greatly to the general prosperity of the mining region.

Gold, as before stated, is to be found in more or less abundance throughout a district of country six hundred miles in length by forty-five in width. It is found in varied quantities, from the surface to the bed-rock, which is sometimes only reached at a depth of two hundred feet.

By means of these extensive and valuable improvements, water sufficient for mining purposes will be gradually distributed over the entire mining region, and millions of acres not now known certainly to possess gold, will be found to abound with the glittering ore.

Actual observation, and the experience of the past, have satisfied me that fifty years hence, when most of those now prominent on the stage of action, shall have passed away, it will be said that mining operations in California have but fairly commenced.

TUNNELLING OPERATIONS.

No section of the United States can present such a picture of active mining as may be seen on the fifteen acres of ground comprising Iowa Hill—of which one writer thus speaks:

I send you a few details of the mining operations that are being carried on at Iowa Hill, a spot of ground which does not embrace more than fifteen acres of the surface of this large State. As the figures are of a nature which, if stated in their gross amounts, might, from their largeness, reasonably raise a doubt in the minds of your readers, I have entered into details as far as I dare without intruding too much on your valuable space, and will state, that in compiling the accompanying table, I have used every means to arrive at as near the truth as possible, and, although in some few companies, shares may have been sold, under the present extraordinary pressure for money, at a lower rate than their estimated value, yet the amounts given are what the shares cer-

tainly have been worth, or sold for, at a time when they could better command their just value than at the present moment. The table includes the name of the company, the distance in feet to which they have run their tunnel, the cost of the tunnel, the number of shares, the estimated value per share, and in the last column I have given the gross amount the shares of each company is worth; I have also added a list of the ditches that have been made in order to bring water to the hill, their extent, and the amount they cost; so that the table furnishes the whole amount of money that up to the present time has been directly invested in developing the mineral resources of this small patch of mining ground; for after all it is but a speck on the surface of our mountains, and is undoubtedly equalled, if not surpassed, in its mineral wealth, by many other spots that yet remain to be worked. Then in our immediate vicinity we have other portions of ground which are, I believe, equally rich; two of these spots have been already proved, viz.: Roach's Hill and Bird Flat, both within a mile of this place. However, I must defer for some future occasion the account of the mining operations carried on in the neighborhood.

In order to render the accompanying table intelligible, a few remarks on tha geological formation of the ground may be useful.

Iowa Hill is formed by a thick layer of gravel and sand, resting on a bed of the older or upheaved rocks. The hill forms the west side of a ridge running N. E. and S. W., and its whole surface does not include an area of more than from fifteen to twenty acres. The layers of ground in which is found the gold, is on the west of the ridge, between two and three hundred feet thick, and gradually thins out as we descend the hill on either side, until at a distance of from two to three hundred yards from the summit, the older rocks on which it rests are found cropping out on the surface. It must not be imagined, however, that this gravel is highly auriferous throughout the whole extent, for although some fine particles of gold can be found almost at any part of the hill, yet it is only the deeper portions of it, or that near the bed rock that afford the richer deposits. It is for the sake of working these deeper layers that the tunnels have been run, and the great extent of these tunnels, and large sums that have been expended on them, are principally owing to the peculiar formation of the surface of the older rock on which the gravel reposes. Had this surface been level, or gently sloping towards the outcrop, nothing would have been easier than to have followed in on the surface of the bed rock, and thus have taken out the richer deposits. But this would have been getting gold too easily, so that nature has so arranged it that the miner has to contend with difficulties which can only be overcome by a great expenditure of labor and capital. Instead of sloping outwards, or being even level, the surface of the bed rock has on all sides of the hill been found sloping in towards the centre, so that the richer deposits lie in the hollow of a basin, and in following them in on the surface of the rock, the miner, immediately he gets below the rim of the basin, finds himself obstructed by water, which is not only up to the level of the basin, but permeates freely through the strata of gravel above. It is for the purpose of draining off this water that these expensive tunnels have been made. They generally enter the side of the hill from twenty to forty feet below the rim of the basin, and are calculated to strike the bottom of the basin, at the lowest point at which the claims in the hill are situated. Large sums of móney have been expended in pure loss by running tunnels which, on account of not having been commenced low enough were found incapable of draining the claims; under these circumstances a new tunnel had to be commenced at a lower level. The cost of making these tunnels depends greatly on the nature of the earth; where the rock is soft they can be run for five or six dollars a foot, whilst in the harder rocks as much as twenty-five dollars a foot has been offered and refused.

	Companies.	No. ft. in tunnel.	Cost.	No. shares.	Val. pr. share.	Total val.
1	Jamieson claim	600	8,000	10	15,000	150,000
2	Hazelgreen	600	10,000	8	10,000	80,000
3	N. Y. & Wisconsin	500	8,000	12	2,400	28,800
4	New Orleans	400	3,000	12	2,000	24,000
5	Independence	250	4,500	20	250	2,500
6	St. Louis			25	500	12,500
7	Kentucky	254	2,700	30	400	12,000
8	Gold Hill	54	120	30	50	1,000
9	Jenny Lind	51	240	30	100	3,000
10	Westport	235	2,500	25	300	7,500
11	Ophir	200	2,000	12	200	2,400
12	Golden Gate	250	2,200	10	500	5,000
13	Eastport	270	3,150	21	400	8,400
14	Mount Flower	230	2,500	20	500	10,000
15	Rough & Ready	137	2,700	16	500	8,000
16	Fort Hope	200	1,040	16	300	4,800
17	Sugar Loaf	250	2,500	20	500	10,000
18	Grass Valley	660	6,000	24	600	14,400
19	North Star	500	5,000	20	600	12,000
20	Cascoo	200	1,700	7	600	4,200
21	South Point	260	1,600	8	800	6,400
22	Hill's Cut		2,000	10	1,000	10,000
23	Union Cut		700	10	600	6,000
24	Bush's Cut	620	3,700	4	3,000	12,000
25	Excelsior	410	2,500	11	1,200	13,200
26	Union G. M. Co.	254	8,700	20	1,600	32,000
27	Iowa Hill	450	7,000	20	1,000	20,000
28	Pakenham	300	2,000	10	6,000	60,000
	Total . .	81,350	$96,050	. . .	. . .	$556,100

Ditches.	Length.	Cost.
Hill's Ditch	3 miles	$3,000
McKee's	14 miles	30,000
Jamieson's	3 miles	2,000
Bush's	2 miles	800
Union	15 miles	12,000
Total cost,		$170,050

The mere inspection of the figures in the above table, will be sufficient to show the large scale on which the mining operations are being carried on, and when we consider that out of one claim, the Jamieson, as much as $280,000 has been already taken, and that their ground would still sell for $150,000, we may fairly conclude that some millions of dollars are destined yet to come out of the Hill. But two or three companies have yet got fairly into the hill, but every one that has reached the lower part of the basin has found rich gravel, and although there is ground being mined, that I think will not pay the expenses incurred, yet the greater part of the companies must eventually succeed. Many of the tunnels have almost arrived at their termini, and a few weeks will decide whether the hopes of their owners will be realized. The sums already expended here, will call for some good diggings to repay them; but for my own part, I have no doubt of the success of the generality of mining operations in this section of country. A tunnel that has just reached the basin at Roach's Hill, about a mile from here, has struck gravel which bids fair to vie in richness with the better part of Iowa Hill, as they have washed dirt which yielded $42 to the pan. At Bird Flat, just across the canon, I saw them washing some dirt that had already been washed, and they were taking out from fifteen to twenty-two ounces a day. Good diggings also have been struck at Richardson Hill and Wisconsin Hill—all within a distance of two miles; however, a description of the amount of work going on at these points, I must reserve for a future communication.

WATER COMPANIES.

The following is a list of the water companies in Calavaras County, and the assessed value of their property:—

There are 13 Canal Companies, located and valued as follows:

Names.	*Location.*	*Assessed.*
Bunker Hill Canal Co.,	Mokelumne,	$ 5,000
Cedar Gulch Ditch Co.,	Rich Gulch,	3,000
Eureka Water Co.,	Angel's,	9,600
Mokelumne Water Works,	Mokelumne Hill,	14,000
Georgia Ditch Co.,	near Forman's,	10,000
Mokelumne Hill Canal Co.,	Mokelumne Hill,	120,000
Extension of do. to Campo Seco (estimated),		90,000
Middle Fork Canal Co.,	Mokelumne River.	4,000
Pope's Ditch,	San Andres,	10,000
Union Water Co.,	do do	15,000
San Domingo Co.,	near Forman's,	800
Table Mountain Co.,	Cave City,	10,000
Union Water Co.,	Murphy's,	100,000
Total,		$391,400

The Nevada *Journal* contains an article in relation to water ditches for mining purposes in that county, stating that the investments made in them are the best in the country, and are sure to pay. Among the successful ditches it names are the Deer Creek ditch, the Rock Creek, the Rough and Ready, and Bowyer's ditch. The last named ditch, the *Journal* says, originally cost $30,000, since which time it has been improved by branch ditches and reservoirs to the amount of $15,000 more. The ditch takes the water from Deer Creek, a quarter of a mile below Nevada, and passing through various diggings, supplies in its course water to almost innumerable paying ravines otherwise unworkable. During the past season, the money accruing from the sale of water from this ditch amounted to $16,000; a pretty good profit on the investment.

A flume has just been completed by the "Empire Ditch Company," which is without dispute, the best constructed affair of the kind in the country. In length, it is 1,960 feet, and at several points in the route, it reaches an elevation of over 60 feet from the ground underneath. It is most thoroughly constructed, the upright timbers upon which it rests, resembling in size and numbers a forest of large pines. It is intended for the conveyance of water upon Massachusetts Hill, and will be the means of opening a vast number of diggings in that neighborhood. It will carry a volume of water sufficient to supply the entire hill.

The *Sierra Citizen*, reviews the winter prospects of the miners in that region a follows:

"At no time have the prospects in Sierra County been better than they are for the coming winter. The mines seem almost inexhaustible; one year's work only serves to open claims which cannot be completely worked out in a dozen years. We of course refer to the tunnelling and hill-side claims, where a vast amount of labor is necessary to make "an opening," as the miners say.

A prospect in some of those valuable claims, would have been very unsatisfactory to an old forty-nine miner with his pan—he would have pronounced it "no color" and tried elsewhere—yet when the improved washing apparatus of the present day is brought to bear on the points and hill-sides, better returns are made than when mining operations were confined to rich gulches and bars on the river; there is a more equitable distribution of profits to the miners, though single individuals do not realize so much in a short time."

A MONSTER LUMP.

The large lump of gold on its way to the Paris exhibition, is thus described in the San Joaquin Republican.

On Monday evening last, the 27th November, by invitation of Mr. Noyes, the agent of Adams & Co., in this city, we had the gratification of seeing the largest "nugget" of pure gold ever found in California, or perhaps in the world.

On the platform scales, used in the office, it weighed ONE HUNDRED AND SIXTY-ONE POUNDS, or *twenty-five hundred and seventy-six ounces*, avoirdupois. Calculating that it contains twenty pounds of quartz rock (which is a large estimate, in the opinion of those who examined the lump), its value, at $17 25 per ounce, is $38,920.

The length of this immense mass is about fifteen inches, and its width from five and one half to six inches. As one side is extremely irregular and uneven in its formation, it is difficult to arrive at the exact thickness, but it will probably average four inches. The other side is almost flat, and presents a solid mass of pure gold; the only quartz perceivable is on the upper or ragged side, and some pieces are so loosely imbedded in the precious metal that, with the aid of a pointed instrument, they might be easily removed. The whole mass, at some period, had apparently been in a fused state.

Mr. Perkins, one of the company to whom it belongs, informed us yesterday that it was taken out in Calaveras County, on Wednesday evening, November 22d, just as the company were about quitting work for the day; he would not give any particulars in regard to where the claim is located, except that it is in the county above named. The company consists of four Americans and one Swiss. Mr. P. belongs to Lexington, Kentucky, and for the past two years, although he has labored hard, was very unsuccessful, never having more than $200 at any one time during that period.

The *specimen* was securely stowed away in a strong box, and despatched to New York, by Adams & Co.

The most beautiful specimen of gold we have ever seen, is now at the office of Wells, Fargo & Co. It weighs about a pound, and was found on San Antonio Creek. It is ornamented on one side with oak leaves, while another part is composed of crystals of gold; one part is an agglomeration of bright particles of river gold, having apparently undergone attrition, before assuming its present formation. Interspersed through the mass, are quartz crystals. It is said that $300 have been refused for it.—*Calaveras Chronicle.*

NEW PROCESS FOR REFINING.

A writer in San Francisco thus refers in the N. Y. Tribune, to a new process for refining gold.

Col. Harazthy, U. S. Assayer in the branch mint, has erected a private refinery to part gold for the mint. He uses a process of his own discovery. There is no humbug about Harazthy; he is a quiet, industrious man, and nothing was known of his invention, till another person connected with the mint spoke of it to a reporter, who then succeeded in worming something out of Harazthy. Harazthy's partner is Julius Froebel. The new process has been put in practice by Harazthy and Froebel, and a process substantially the same is to be used in the Refinery, now in the course of erection by Kellogg and Ringel. Harazthy's invention will reduce the cost of refining 30 per cent., and will entirely supersede the present method. Such, at least, is my opinion from all I can learn of it, and of the discoverer. One great objection to the method of refining now in use is, that it does not cleanse the gold of iridium, a metal of little value but sometimes very plentiful in native gold. Harazthy takes out the iridium as thoroughly as the iron and lead.

QUARTZ MINING IN AUSTRALIA.

Some very fine specimens of auriferous quartz, stated to have been brought down by Mr. Shaw, from the M'Ivor gold field, were yesterday exhibited at the Chamber of Commerce. We have seen Mr. Shaw, who states that he has traced the quartz lode for seven miles; that it averages two feet thick: and that every where he has found it to be auriferous. The quartz we have seen is extremely rich in gold, and if the specimens are any thing like an average, it seems certain we are only in the infancy of gold digging. Mr. Shaw is one of a party who are doing well by hand-crushing. They have sunk fourteen feet from the lode, and find it continue of equal bulk. The want of machines is extremely felt, and the diggers are organizing a company to procure a Berdan. For our parts we think that the capitalists of the colony could not do better than send for a dozen Berdans, as there seems to be, at M'Ivor, Mount Alexander, and Bendigo, alone profitable work for them for any length of time. An experienced colonist has suggested to us, that probably the best plan for the towns-people, would be to subscribe a sum to pay the travelling expenses of a number of gentlemen of established character, who should examine the various diggings, collect specimens of quartz from the lodes, and get them tested. This would afford a business-like basis for the establishment of quartz-crushing companies, and push the colony forward in the career of gold production more effectually than by any other plan.—*Sidney paper.*

GOLD AMALGAMATION IN SOUTH AMERICA.

The Tyrol machinery was applied to one of the stamping mills at Marmato in 1833, and kept occasionally at work, experimentally, until 1834, when the machine was moved as useless, as far as economy, despatch, and efficiency were concerned. I could name a variety of other contrivances that were tried. Also, the roasting, barrels, cementation, the conversion of the sulphurets into partial sulphates, &c. Yet, until 1839, we found stamping, dressing, and the arrastre amalgamation the best, although the monthly loss of mercury was very great. In 1840, it was found that the native process, improved, and without the use of mercury, was cheaper, and a greater proportion of gold was obtained with the aid of the natural decomposition of the remains, and repeated washings, than by the fine grinding in the arrastres, &c. This continued until 1846, when the mode of stamping and dressing was altered and much improved. Instead of allowing the stamped ore to run into the stamp pits direct, as heretofore, I introduced long inclined planes, covered with a series of blankets, &c., and thus detected more than two thirds of the gold at once, and comparatively in a clean state and the finest grains. Instead of attempting to extract the remainder of the gold at once, as formerly, by laborious and expensive fine grinding, &c., we placed the remains aside for decomposition and re-washing over blankets, until the whole of the refuse disappeared. Hence, by the present simplicity and economy of the operation, nearly the whole of the gold is obtained, at an expense not exceeding 8s. 10d. per ton in the wilds of America, as already described in your Journal of the 15th and 29th April.—EVAN HOPKINS.

GOLD IN SOUTH AFRICA.

A wide region in Southern Africa, to the north of lat. 33° 30′, and three times the extent of the British Isles, is occupied by horizontal fossiliferous strata, characterized chiefly by the remains of extinct reptiles (*Dicynodon*) and vegetable remains. These strata were first described by Mr. Bain: they are chiefly sandstones, with calcareous nodules, the latter often enveloping the fossil bones. This formation is every where intersected by dykes and veins of igneous rock (basalt and sienite), which are mainly vertical, and vary from one foot in thickness to some hundreds of yards. They frequently protrude

along mountain ridges; and the basalt also overlies the surface, forming the capping of hills and plateaux. The strata are but slightly disturbed, and not much altered, and that only close to the dykes. Iron and manganese occur in the dykes and the strata. Some small nuggets of gold having been found near Smithfield (on the Caledon), in the Orange River sovereignty (about 30° 10′), Mr. Rubidge and Mr. Paterson were sent to report on the subject. They found that the gold had been met with in two dykes, running north and south, parallel to each other, and about a mile and a half apart; and also in the gravel of the shallow valley between the dykes. These dykes contain some quartz veins, in the cavities of which the gold was discovered, but in small quantity. A fragment of calcareous rock, entangled in the trap-dyke, was also found to contain a little gold. At Kraai River, near Aliwal, on the Orange River (40 miles south-east of Smithfield), gold was found in quartz surrounding a mass of calcareous sandstone in the trap-rock. The gold from Kroomberg was also found in a dyke. Mr. Rubidge considers that the supply of gold is very limited, its source being the quartz veins in the trap-rocks; and that the gold in the gravel above referred to was not brought from a distance, but derived from the decomposed trap-dykes of the vcinity. The author notices that, as far as his observations went, he found the gold-bearing dykes to have a north and south, or meridional, direction. He finds it difficult to classify the trap-dykes of this region, but considers that the north and south dykes, which form the centres of many ranges of hill and mountain, to be the most ancient; they are crossed by a set of dykes having mainly a north-east and south-west direction. Mr. Rubidge describes also a band of anthracite, between Aliwal and the Stormbergen, which becomes converted into plumbago by contact with the igneous rocks; and he notices the occurrence of agates in the Orange and Sunday Rivers.—*Proceedings of Geological Society.*

GOLD IN RUSSIA.

This metal, as well as silver, is almost exclusively confined to the Ural Siberia, or the Caucasus. In Russia in Europe, the extraction of the gold is limited to a number of deposits of auriferous sands, on the west side of the Ural Mountains. There are two deposits as well in the Government of Archangel, but these were abandoned in the last century. The one was a mine of silver, on the Island of Medveji, in the White Sea; the other of gold, called Voitsk, in the district of Kemi, not far from Olonets. At this last spot the explorations commenced in 1745; they were resumed in 1772 and 1792, and finally abandoned in 1794. The produce, during a period of 37 years, was 180 lbs. In Russia in Asia, gold is found in the Governments of Perm, Orenbourg, Tomsk, Yenisseisk, Irkoutsk, and the Kirghisian districts. The first discovery of gold was made in the year 1743, in the environs of Catherinebourg; the operations were commenced in the year 1752, and have continued to the present day. The maximum product of these mines, which are named Berezof, was in 1810, when it attained to 880 lbs.; at present it only gives 80 lbs. a year, which is scarcely sufficient to keep up the workings. On this account numbers of other deposits in the Ural have been abandoned. In the year 1823 there were 66 of these opened; at present there are only eight at work. The first exploration of the auriferous sands in the Ural, dates from 1814; this was on Crown lands. In 1819, private individuals likewise availed themselves of the deposits on their properties. The washings in Western Siberia were commenced in 1829, and in Eastern Siberia in 1838. The total produce of gold in Russia from the mines and washings, from the year 1752 to 1850, was 850,760 lbs.; of this 723,660 lbs. had been obtained from washings, and 726,400 lbs. have been produced since 1826. In Eastern Siberia, since 1847 the yield has considerably diminished, showing in the year 1850, a decrease in the production as compared with the year 1847 of 14,520 lbs. The works of Verkh-Isset, belonging to M. Yakovleff, formerly gave about

2000l bs. annually; these have, however, considerably fallen off, and it is estimated this branch of industry has attained its highest limit.

The Australian gold chain is exactly 90° from the Ural chain, and from the same chain it is exactly 90° from the Californian. The fourth quadrantal meridian falls in the Atlantic, between Brazil and Africa, both auriferous. In the Ural, Australian, and Californian gold ranges, bones of extinct animals are met with in the auriferous detritus, thereby proving that the geological character of these formations is identical.

JOURNAL OF COPPER MINING OPERATIONS.

LAKE SUPERIOR REGION.

Copper Falls Mine. From the last report of Mr. S. W. Hill we gather the following facts relative to operations at this mine during the past year.

It was not until the first of last May, that our stamping mill could be got into operation, and then only sixteen heads were in readiness. As is the case in all new machinery, these required adjusting, some alterations, and some necessary accompanying fixtures, before they could do their full duty. It was not until the first of June that they were in complete running condition.

Soon after the first of June, we found a want of sufficient water to stamp and wash vigorously, in consequence of its being brought to the mill in board pipes, from which a considerable portion of it was lost. We had sent for iron pipes in March previous, and were daily expecting them; they did not reach the mines until July, when they were put in use without delay. Since then we have had a good supply of water with the exception of about one week. In the latter part of the past winter, preparations were made for getting into use, in the early part of the summer, eight additional heads of stamps, making up the whole number to twenty-four. Castings were then ordered, and they should have reached the mines by the first of June. They were received in August, and, soon after set to work. From that time to the first of October they ran well, and did a good business at getting out copper. On the first of October, one of the journals to one of the stamp axles was broken, and could not be replaced until the first of this month; hence, during the month of October only sixteen heads of stamps were run. The whole number of heads are now running, and will produce, this month something over twenty tons of copper.

We now have at the Harbor, castings for twenty-four more stamps, which will be got in running order as soon as possible. With this additional stamping power, we expect to produce from the stamping mill, an average of thirty-six to forty tons of copper per month.

In the Hill Mine, and between shafts Nos. 4 and 5, in the back of the adit gallery, I had expected over one hundred and fifty tons of mass copper during the past season. This back of copper ground, in that mine, was examined by very many persons during the past winter and spring, and was thought by all to be well filled with mass copper; our mining captains believed there could be no doubt of the value of that part of the mine for mass copper; none fixed the estimate at less than the number of tons specified above. Upon these appearances, in the early part of the season, I estimated that we would be able to produce between three and four hundred tons of copper this season. I had calculated upon one hundred and fity tons from the stamp mill alone. This amount has not been produced, owing to obstructions and delays which could not be avoided. The back of ground referred to in the Hill Mine, has been found to produce but little mass copper; but a great amount of stamp work,

from a lode over seven feet wide. Not more than one half of the back has been stoped away to this time. There are masses of copper in the level above, but they cannot be taken away until, by due course of working, the stopes are carried upward to them. The produce of the mines, in marketable copper, this season, will not exceed one hundred and fifty tons; nearly that amount has been carried to the lake at this time, and over one hundred and thirty tons shipped to the smelting house. The per centage yield of that, thus far, sent to the harbor, will not be found to vary much from seventy per cent.

We now have upon the surface at the stamping mill and about the mines, 1,000 tons more stamps work, than was on the surface at the time the mill was got to work. Lying upon one of the stulls in the Hill Mine, south of shaft No. 5, already broken and blasted down, are 1,000 tons of stamps work, ready to be taken to the surface when it shall be wanted, or when a place about the shaft, at the surface, can be had to put it upon.

In the adit gallery, near shaft No 5, Hill Mine, is a mass of copper which we have been cutting up. It is standing in the vein at this time, with only a part of it exposed to view. It was expected that 20 tons of this mass (the estimated amount of it in sight,) would be got to market this season. Owing to the work of cutting being suspended during some ten days, while the men were on a strike, and the greater thickness of the cut than was expected, no portion of it will be got out of the mines, until after the close of navigation.

Early in the spring, a large stoping force was set to work in both mines. In a very short time it was found that we could not handle the stamps work. The stoping force was reduced to about 24 men in the two mines, while we had between 70 and 80 men extending the shafts and galleries. The result has been that we now have a much greater number of fathoms of backs containing copper for stoping, than we had at the time the last annual report was made. In the Copper Falls Mine, but little stoping has been done. The work of extending the shafts and levels, has gone forward steadily to the present time. Some parts of the galleries have been opened by contracts in cubic fathoms. This has been the case where the vein is from seven to fourteen feet wide. There are such places in the Copper Falls Mine. and some of them over one hundred feet in length, and well filled with stamp copper.

During this season, the mines might have been so worked that the expenses would not have exceeded four thousand dollars per month, and the same amount of copper taken from them, which we have now taken out. Some 24 miners might have been set at stoping, and no other mine force employed, and 30 to 40 surface men could have done all on the surface; at least, sufficient to have gone along for the present. It has not been my intention, since these mines were commenced, to open ground during the winter, and stope it out during the summer, and so on from year to year. Twenty-four miners might have stoped the backs of these mines, commencing on the first of June last, for a term of three years, and then not have got out all of the copper, to the extent of the extension of the shafts and galleries opened to June last; twenty-four stopers can take out stamps work enough to keep twenty-four stamp heads fully supplied.

Such a course of working cannot be the true interest of this mine. There is a future, in which the mine as it has been worked, WILL TELL. That future is not far off; we have gone forward in the opening of the mine, during the summer past, in every part, where it seemed advisable to open and work, within a year or two hence. We have determined upon the amount of stamps work we can produce from year to year. By this mode of working, we are enabled to see what amount of stamping power we require for the future. As soon as the number of stamp heads we propose to work, with the engine we now have, are running, we shall require another engine and sixty-four heads of stamps, and we shall be able to supply them as soon as they can be erected. The amount of stamps work which the Copper Falls Mines can produce, I have never until this season, estimated to exceed that which forty-eight heads of stamps could work up. I am now prepared to state that these

mines can produce more stamps work than one hundred heads can pulverize, and this amount can be taken out without any extraordinary exertions at mining. Calculations can be based upon stamp stuff; they cannot upon the produce of masses; these are liable to be met with when least expected, and may not be found where there is every reason to expect them, from external appearances. The stamp stuff, can be estimated when we have shafts and levels extended in the lodes to distances, which will enable us to determine that we have some thousands of fathoms in backs ready to be stoped, containing copper mixed through the rock, or vein stone. The twenty-four heads of stamps now running at our mines, will produce enough copper to pay our expenses at this time, twenty-four heads more would give us a small profit, of probably not less than $50,000 per annum. Another mill of sixty-four heads more, would give us a proportional additional profit. The mill will be required, and must be erected within eighteen months. While this amount of stamps work is being taken from the mines we may expect to get some masses of copper; we have some in the mines now, and expect more will be met with ere long. At one time it was denied that our mines would produce masses of copper. That question was settled some time since. Then it was said that we could not produce stamps work. I can but think that *that* question has been settled also. The incredulous may think we cannot pay a profit; in due time they will be able to see a favorable solution of that question.

The Cliff Mine. The financial condition of this enterprise is thus described in the last report of the Directors. They have been the most successful copper mining company in the country:—

The amount of mineral, of last year's product, *unshipped* at the close of the mining year, on the first of December, was 165,948 pounds. A part of this, say 59,011 pounds, was shipped on the 16th of May, being the first shipment of the season; and a further portion, 61,042 pounds, on the 24th of May; and the residue on the 2d of June: but no part of it arrived in Pittsburg until about the 10th of June. The whole of it, however, has been smelted and sold, and the Directors are thereby enabled to present the actual results of the whole year's operations.

The mineral raised from the mine during the year, say from the 1st December, 1852, to the 1st December, 1853, amounted, when prepared for shipment, to 2,263,182 pounds, or $1,181\frac{1182}{2000}$ tons, of the following, viz.:

Mass copper,	632,496	lbs.
Barrel ore,	535,799	"
Stampings,	1,094,887	"
Total,	2,263,182	"

This produced in pure Copper 1,071,288 pounds, or a fraction more than forty-seven per cent. (say $47\frac{335}{1000}$).

The proceeds of the same, when converted into money, amounts to the sum of $\$292,647\frac{95}{100}$ *after paying the expenses of smelting and refining.*

The expenditures for the same period, as brought on to the books of the Treasurer, and which appear under their appropriate heads in the annexed balance sheet, were $\$181,869\frac{2}{100}$, leaving a balance of receipts over the expenditures of $110,778\frac{93}{100}$, which, deducting therefrom the sum of $\$3,743\frac{23}{100}$, being the relative increase in the indebtedness of the Company *at the mine*, as compared with the inventory of supplies at the corresponding period of the previous year, makes the clear net earnings of the Company for the year $\$107,035\frac{70}{100}$, or a fraction less than $18 per share, explained as follows:

Net proceeds of sales of copper . . .	$292,647.95	Expenditures, as per balance sheet . . .	$181,869.02
Cash and supplies on hand at the Mine, December 1, 1852, $24,982.14		Indebtedness at the Mine, Dec. 1, 1852, $36,136.46	
Do. Dec. 1, 1853, 37,967.97		Do. Dec. 1, 1853, 52,865.52	
Increase	$12,985.83	Increase	$16,729.06
		Balance	107,035.70
	$305,633.78		$305,633.78

Balance, being the net profits for 1853, $107,035.70.

The statement of assets and liabilities, shows a balance of personal effects, as of date the 1st December, 1853, of $\$116,949\frac{45}{100}$, out of which a dividend of *ten dollars* per share was paid on the 27th February last, amounting to $60,000; and a further dividend of *eight dollars* per share, amounting to $48,000, has been declared, payable on the 11th of September.

This statement is free from the objection to which all the previous statements were obnoxious, of being based, to a large extent, upon *estimated* values of mineral on hand, and which were, as has already been remarked, subject to very material modifications when the mineral came to be smelted and marketed; and presents the *true surplus*, based upon the actual results of sales of the copper, and a correct inventory of the personal effects at the mine.

In this connection, it becomes necessary to review the statement of assets and liabilities presented with the last annual report. That statement was predicated upon an *estimated* value of the copper and mineral then on hand, amounting to $\$128,884\frac{92}{100}$, but which actually yielded but $\$112,414\frac{45}{100}$, making a difference between the estimated and actual results of $\$16,470\frac{47}{100}$. The following items also properly belong to the accounts of 1852, but which were not liquidated and paid till 1853, as will be seen by the balance sheet, viz.: For Insurance, $\$2,354\frac{21}{100}$; and for Freights, $\$6,403\frac{48}{100}$.

The actual surplus, therefore, of the 1st December, 1852, would stand as follows:

Surplus, as per estimate, including $1,120 unpaid dividends,		$128,336.91
Deduct—		
Over estimate of copper and mineral, . .	$16,470.47	
Insurance, ...	2,354.21	
Freights, ...	6,403.48	
		$25,228.16
Actual surplus, Dec. 1, 1852,		$103,108.75
From this surplus there was paid to Stockholders in dividends, ...	$89,725.00	
Paid for erection of cupola furnace, . .	2,450.00	
		$92,175.00
Balance carried to next year,		$10,933.75
The clear net profits of the year 1853, as before stated, were		$107,035.70
Received for rents at furnace, ...		375.00
Balance from the year 1852, ...		10,933.75
		$118,344.45
Deduct dividends unclaimed, ...		1,395.00
Surplus, as of date Dec. 1st, 1853, ...		$116,949.45
From this surplus, dividends have been declared, as stated above, amounting to		108,000.00
Leaving a balance to be carried to the year 1854 of .		$8,949.45

This sum of $8,949$\frac{45}{100}$ is the available balance of the personal effects of the company, and does not include any of its real estate, improvements, or mining machinery; it having been the design of the directors to embrace nothing in the schedule except such articles of supplies and munitions for mining as will be available to the company in lieu of so much money. In other words, this balance is all that remains of the capital stock which can properly be considered *working capital*, the residue having been invested in the purchase and improvement of the property, erecting buildings, machinery, &c. And when it is observed to be only equal in amount to about one fifth of the sum invested in supplies alone on the 1st of December last, its inadequacy must be quite apparent.

Were it not for the circumstance that the dividends are paid semi-annually, so as to afford time to the treasurer to replenish his coffers, to some extent, from the sales of the current year, about the time of paying the last of the semi-annual dividends it would be quite impossible for him to meet the current demands upon the company without serious inconvenience. Nor could he do so at all, even with this adventitious aid, but for existing arrangements with responsible parties at Pittsburg, by which the company is enabled to realize the cash upon delivery of the copper, to the extent of about two thirds of the annual product of the mine.

By such of the stockholders as know the difficulty of effecting sales of copper for cash, at satisfactory prices, the advantages of this arrangement will be appreciated. The customary and almost universal mode of selling copper in the eastern markets is on time, and at the present moment it is quite impossible to elicit a cash offer except at prices which the necessities of the company would neither authorize, nor justify.

As an illustration of the difficulties here referred to, it may be remarked that the first hundred tons from the mine this spring was sent to our very intelligent and sagacious agents in New York, a part of which was in their hands as early as the latter part of June, and the proceeds of which were designed to aid the treasurer in the payment of a dividend to the stockholders in August; and up to this period they have not been able to elicit a satisfactory cash offer, and have only been able to sell a part, and the smaller part of the consignment, on the usual credit of four months.

In view of all these facts, the directors are of the opinion that the working capital should be increased until it shall amount to a sum equal at least to one half of the ordinary yearly expenditures. This may be done without calling upon the stockholders for an increase of the capital stock, which is by no means advisable or desirable, but by hereafter withholding a portion of the annual earnings.

The operations have, so far, been confined to one of the several veins known as the Cliff vein. This vein extends from the shore of Lake Superior, in a southeastern direction, to the extreme southern boundary of the location, a distance of nearly three miles; and for about two thirds of that distance, passes through a geological formation highly favorable for minerals; but so far, the mining operations have been confined to the southern end of the vein, embracing a range of only about twelve or thirteen hundred feet. Here the vein has been penetrated, to the depth of 462 feet below the adit level. From this comparatively small part of this single vein, there has already been extracted copper and silver to the amount of $1,323,406$\frac{83}{100}$, after paying the cost of smelting and refining the same. It may be safely asserted that the history of mining nowhere furnishes accounts of so large an amount of mineral wealth being produced from the same extent of ground.

The dividends of the company commenced in 1849, since which period regular semi-annual dividends have been paid to the shareholders, which amount, including the dividend payable on the 11th inst., to $77 per share, or the aggregate sum of $462,000. And the directors feel warranted in saying that there is nothing in the present appearance of the mine to justify the con-

clusion that future operations will be productive of less satisfactory results. On the contrary, there is good reason to expect that the net annual receipts will hereafter be largely increased.

Circumstances may occasionally arise which it will not be in the power of the directors to control, to render one season less productive than another, such as the scarcity and high price of labor and supplies, and other contingencies to which the business of mining is peculiarly liable. But looking to a series of years, there is abundant reason to expect that the future earnings of the mine will exhibit a steady, progressive increase.

Adventure Mining Co.—The following is the balance sheet of this company as presented in their report for October last:—

EXPENDITURES.

Aggregate expenditures to June 21st, 1852, date of last Report,		$45,260 57
Expenditures from June 21st, 1852, to Oct. 2d, 1854, as follows, viz:		
For supplies, freight, &c.,	$11,131 07	
For labor, &c., at mine, per drafts,	23,372 73	
For cash sent to mine and assessments collected at mine, and applied to labor, &c.,	4,424 32	
Ontonagon Plank Road, paid remainder of subscription,	2,695 62	
Office expenses, salary of Secretary, &c.,	1,890 71	
State Tax,	1,143 83	
Machinery,	93 88	
Insurance,	97 74	—44,349 40
		89,609 97
Due to the Company—Accounts Receivable,		74 93
Adventure Mining Co., Stock cost of 33 shares, forfeited and bought by the Company,		105 75
Cash in hands of Treasurer,		164 42
Total,		$89,955 07

RECEIPTS.

Capital Stock paid in prior to July 1st, 1850, see last report,	$2,645 00	
Assessment No. 1,	5,000 00	
Assessment No. 2,	10,000 00	
Assessment No. 3,	10,000 00	
Assessment No. 4,	10,000 00	
Assessment No. 5,	10,000 00	
Assessment No. 6,	10,000 00	
Assessment No. 7,	10,000 50	
Assessment No. 8,	9,880 00	—77,525 00
Received for sales of copper,		10,388 94
Exchange and Interest,		345 84
		$88,259 78
Debts due by the Company—Accounts payable,		1,695 29
Total,		$89,955 07

EAST TENNESSEE COPPER MINES.

The following letter from Mr. Lyman W. Gilbert, contains some facts respecting the product of these rich mines. It is dated Athens, Geo., Dec. 6th, and directed to the cashier of the Ocean Bank:—

Related as your Bank is to the mining interests of East Tennessee, I have thought that a few statistics respecting that business in Ducktown, might not

be uninteresting. During a short trip to the mines I picked up the following facts, to wit: From the 1st to the 30th of November, the Tennessee mine sent away about 140 tons; the Polk County Mines over 200 tons, and the Isabella Mine over 300 tons, teamster's weight, all rich ore ranging from 22 to 30 per cent. copper. It may not be uninteresting to know that the Polk County Mine commenced work about the first of May last, and the Isabella Mine about the 23d of August a year ago. What the above mines did last month, they can continue to do. The Hiwassee and the London Mines, sent away very considerable quantities of ore in November, but just how much I am unable to say. * * * * * * * There was some $15,000 paid to teamsters last month for hauling away ores. There are some 500 teams employed in the service, beside many others employed at the mines in hauling logs, board, feed, &c. It requires no small amount of feed to support 500 or 600 teams, of four to six heads each, and I trust that after this season there will be no lack of feed near home, not for 600 teams only, but 1,200 teams, as that number will probably be required another season.

The mines furnish a good cash market for every kind of produce from the farm, besides employment for hundreds of men, and many hundreds of teams. One farmer told me to-day, as I was coming from the mines, that notwithstanding he had a good crop this year, yet he could not feed all the teams employed by the mines for a single night.

A railway from the mines to the East Tennessee, and Georgia Railroad is all important, and if capitalists from abroad shall consent to aid in the construction of such a road, I trust that the citizens of Polk and Bradley Counties will not be backward in coming up to their help. The benefits of a railway will not be confined to the mining interests, but will be felt by every farmer, mechanic, tradesman, and citizen within the district.

THE OCCURRENCE OF COPPER IN TENNESSEE.

The gneiss and mica schists of Eastern Tennessee strike north-east and south-west, and dip to the south-east, running parallel to, and forming an outer range of the Alleghany Mountains. Veins of copper and iron ores, with occasional quartz, lie in the schists, dipping parallel with them, and consisting of porous oxide of iron at top, iron pyrites, and carbonate and sulphuret of copper below. The veins are described as traceable for upwards of 70 miles, but they are worked chiefly in the extreme south-east corner of Tennessee, in the township of Duckton, in the county of Polk, a district ceded by the Indians to the State, and settled about four years ago.—*W. Bray.*

MINES IN FANNIN, GEORGIA.

There is no county in the State so rich in minerals as Fannin. The White Path Gold Mines are in active operation, and are yielding handsomely, while a large number of persons are testing for copper in various portions of the county, with fair prospects of success. Up to this time, however, but one company in Fannin, or in this State, have succeeded in raising copper. The mines of which we speak, are located in the eighth district; about one and a half miles from Pierceville, and are owned by Messrs. Smith & Summerour. They have already raised over *twenty tons* of ore, and are preparing to increase their force. When in full operation, they will employ from 250 to 300 hands, and will probably ship more ore than any other company now mining.

These mines are about 60 miles distant from Dalton, and about the same distance from Cartersville. The ore will be transported in wagons to one or the other of these places, and then shipped either to Charleston or Savannah. The company prefer to ship by way of the former city, if the Georgia and

S. C. Railroad will make the expense the same as by way of Savannah. The amount shipped in the course of the year, by this one company will be sufficient to make it an object for these roads, to see that their scale of prices is so arranged as to secure it, and we respectfully call their attention to the matter. If other mines in Fannin and Gilmer, prove as valuable and productive, as there is every reason to believe they will, the entire business of transporting the ore might be secured by these two roads, if proper measures are adopted.

The mines of Messrs. Smith & Summerour, are among the richest that have been discovered. They yield the black oxide and the green carbonate of copper, some of which is thought to be worth at least 80 per cent.—*Cassville Standard.*

The quantity of copper ore arriving in this city, from the mines of Upper Georgia and Tennessee, is becoming quite an item. During the month of November, 1,597 boxes were received from Dalton, and nearly or quite as much from Tennessee. New mines are almost daily discovered, in various regions of this State and Tennessee, and many of them are proving highly productive. The Atlanta *Examiner*, of the 14th, acknowledges the receipt of several exceedingly rich specimens of ore, found at the depth of thirty-five feet below the surface of the earth, in a shaft sunk by Mr. John Dunlap, on a spur of the Lookout Mountain, in Dade County.—*Savannah Republic.*

STANTON COPPER CO. OF MISSOURI.

A correspondent of the St. Louis Republican thus reports the progress of this company:

On the 28th of October, the members of the Stanton Copper Company, published a notice in your paper of a dissolution of partnership, without taking the precaution to add that said dissolution was not with a view to stop the mining and smelting of copper, but merely to change a private partnership into a corporate concern.

The impression made upon the public mind is, that we have closed business at the works, and either sold out or abandoned the enterprise. Nothing could be further from the fact; for, although the old partners have converted their works into a capital stock of $100,000, under the general incorporation law of Missouri, they still continue operations at the mine and furnace, and have made the change mainly with a view to the employment of a larger capital and the more expensive exploration of their valuable mine.

Both mining and smelting are now in active operation, as you will have occasion to know from the frequent loads of copper that will be stored opposite your office.

Of the $100,000 capital stock the former partners have taken $60,000, and they think of offering the balance for sale, for the purpose of sinking to a much greater depth upon their vein. One shaft is 95 feet in depth, one is 115 feet, and another 150; and the deeper we go the richer the ore, as in all good copper mines.

A steam engine is in operation upon the mine, and also one at the furnace, the mine and furnace being three fourths of a mile apart—and all the necessary buildings erected at each place, such as boarding-houses, offices, men's houses, stables, smith shops, coal houses, &c., &c.

The name of the new company, is the "Stanton Copper Mining Company," and all the old partners came into it with a determination, to bring a capital to bear upon the work, sufficient to reach the richest portions of the mine.

St. Louis is deeply interested in the proper and successful development, of the great mineral wealth which lies so close at her door—and the members of this Company have proven that strong, permanent and well-defined copper veins do exist in the valley of the Maramec, within seventy miles of your city.

We are, in short, about to prove what the State will be anxious to know

from her geologists, that well-defined and profitable copper veins do exist in abundance in our silurian formation, the great lead-bearing rock of Missouri—which is richer in metals than any other similar formation in any part of the world.

MANNER OF TREATING MATTS OF ARGENTIFEROUS COPPER.—BY M. KUDERNATSCH.

(Translated from Le Technologiste for the Mining Magazine.)

Every one knows what difficulties are experienced, and how much money and time it costs to extract silver from black copper by the process of washing, and this same extraction in the matts of this metal by means of lead, difficulties so great, that in ores containing less than $\frac{3}{1000}$ of silver, the value does not pay the expense of extraction. It is to M. Ylionhauser, of Germany, that belongs the merit of having called attention to the processes of amalgamation of ores at Schmelnitz; as for the argentiferous copper of Mansfeld, this process cannot be applied, because it is too hard to be calcined, broken, &c. Therefore they have preserved at Hettfstad the process of washing until 1851, when the process of amalgamation was introduced by M. Ziervogel, at the mine of Gottesblonung, and where it has been applied in part. But the little certainty presented by this process, the expense entailed, the dangerous influence of the vapors of mercury and chlorine, &c., have for some time made desirable a change in this metallurgical operation. MM. Augustin and Ziervogel have, in consequence, occupied themselves with experiments to extract the silver from matts by a solution of marine salt. These experiments, conducted on a large scale by M. Augustin, produced, in 1844, a very considerable economy in the working. M. Ziervogel, in 1848, succeeded in replacing this process by another more simple, and more economical, and of assured success. It consisted in this.

The argentiferous matt is roasted two or three times in a reverberatory furnace, until it presents a richness of about 60 per cent. of copper, and from $\frac{375}{100,000}$ to $\frac{464}{100,000}$ of silver; the matt is at the same time purified of foreign matters. The concentrated matt is then stamped, wet, and the farina which comes from it roasted with care, and without any addition, in a reverberatory furnace of two soles, one above the other. The first roasting is made on the upper sole, which is completely isolated from the fire, and the second on the lower sole, which is open to the fire. It is necessary to avoid with the greatest care the matt forming into a mass. The roasting in the second part of the furnace, when it has been sufficiently prolonged, and the heat sufficiently elevated, destroys almost entirely the sulphates of the oxide of iron and of copper, in driving off the sulphuric acid which volatilizes. The sulphate of silver which is formed, resists longer this decomposition, and it is on the happy discovery of this property that is based this process.

A roasting of 4 hours on the upper sole, and as much on the lower one, for a charge of two metrical quintals (440 pounds) conducts, when the operation is watched with care, to a complete success. The roasted farina is sifted to get out the nuggets, and the sifted portion, after cooling, is washed in boiling water. The precipitation of the silver from the solution of the sulphate, is executed by plates of copper; the precipitated silver is washed, formed into balls and melted in a reverberatory furnace. Seven roasting furnaces of the kind indicated, with eight vessels for washing, and ten for precipitation, disposed in steps, one above the other, and provided with double bottoms, pierced with holes, and covered with coarse cloth, suffice to work annually 1500 metrical quintals (1650 tons) of copper matts. The expense is small, and the loss of silver scarcely 8 per cent. The refined copper from the residue does not contain over from $\frac{30}{1000000}$ to $\frac{45}{1000000}$ of silver.

JOURNAL OF SILVER AND LEAD MINING OPERATIONS.

ENGLISH LEAD WASH.

Estimate of silver produced from the mines of Great Britain and Ireland in the year 1853:—

County.	Av. proportion of silver in each ton of lead.	Silver in each district, as per actual assay.	Estimated total quantity in each district.*	Value at 5s. 6d. per oz.†
Cornwall	Ozs. 35	165,670	200,000	£55,000
Devonshire	40	106,236	110,000	30,250
Cumberland	9	13,730	50,000	13,750
Durham, Northumberland and Westmoreland	12	74,700	140,000	38,500
Cardiganshire, Carnarvonshire, and Carmarthen.	15	30,567	60,000	16,500
Flintshire & Denbighshire	7	30,714	50,000	13,750
Montgomery & Merioneth	6	4,229	5,000	1,375
Ireland	10	17,664	25,000	6,875
Scotland	8	5,860	10,000	2,750
Isle of Man	20	47,105	50,000	13,750
Total		496,475	700,000	192,500

Table showing the total quantity of lead ore raised and smelted in the United Kingdom in the year 1853:—

	Lead Ore.		Lead.	
England,	Tons 59,842	17	41,897	14
Wales,	17,131	4	12,870	7
Ireland,	3,309	10	2,452	7
Scotland,	2,799	7	1,919	4
Isle of Man,	2,460	0	1,829	0
Total,	Tons 85,042	18	60,963	12

Lead ore and lead imported and exported in 1853:—

	Tons.	ct.	q.
IMPORTED.			
Lead ore,	733	1	0
Pig and sheet lead,	17,564	8	3
White lead,	31	12	3
EXPORTED.			
Lead ore,	488	0	0
Pig and sheet lead,	14,935	0	0
Shot,	1,307	0	0
Litharge,	316	7	0
Red lead,	1,025	13	0
White lead,	1,528	8	0
Foreign lead re-exported,	1,438	16	0

Total quantity of tin ore raised in Devon and Cornwall in 1853,—8,866 tons; average value, about 68*l.* per ton. The black tin, or tin ore, produces on the average 65 per cent. of metallic tin—therefore, there was produced of white tin about 6,000 tons.—*London Mining Journal.*

Summary of the produce of lead, silver, tin, and copper, for 1853, from the mines of the United Kingdom, or sold at Swansea:—

* This estimate has been made from numerous approximate returns which have been received. A large quantity of lead passes into consumption from which the silver is not separated, and so much is mixed with foreign ores and smelted, that the exact amount cannot be at present determined.

† This I find the present price for pure silver.

Metal.	Tons.	cwts.	Ounces.
Lead,	61,021	2	—
Silver,	—		700,000
Tin,	6,000	0	—
Copper—Cornwall and Devon,	11,918	12	—
Ireland,	1,116	15	—
Sold at Swansea, from other parts,	3,442	5	—

SILVER IN RUSSIA.

Ores of silver are found in lead lodes: the principal works are in Siberia, in the districts of Altai, and Nertchinsk; there are others, but their exploration is more recent, in the Caucasus, the Kirghissian steppes, and Irtysch. In the Altai, silver has been worked since 1743; the produce from the mines here in 1849 was 66,760 lbs. In the district of Nertchinsk, the workings were commenced in 1704, and to the year 1747 their produce was 1,120 lbs. yearly; in 1775 it had reached to 25,200 lbs., but it has since then diminished, and the produce is now about 8000 lbs. In 1804, these mines furnished to those of Altai from 200 to 300 tons of lead per annum, and were enabled to dispose of about 60 tons: in 1849 the produce was 8,169 tons of lead, containing 73,080 lbs. of silver; in 1850 the works were ordered to be partially suspended, in order that auriferous researches should be prosecuted, and only 2,720 lbs. of silver was raised. The ores from both these mines contain gold. In the Mint at St. Petersburg, in 1846 they got from 47,760 lbs. of silver to 1,840 lbs. of gold. There are likewise rich deposits of silver at Irtysch, in the districts of Karkaralinsk, and Baian-Aoul: from 1844 to 1850 they yielded 175 tons of lead and 1,008 lbs. of silver; the smelting works here use coal. In the Caucasus, at Kazbek and Elborus, there is argentiferous galena; it is likewise found in Daghestan and the Daralaghez Mountains, but the richest deposits are in Georgia, near the convent of Akhtal; these are now abandoned, but were actively worked in the last century. The mines of the Caucasus are only explored by the natives on account of the lead. The Emperor intended to establish reduction works 40 versts from Vladikavkaz, in the gorge of the Alaghir, the annual product of which was fixed at 720 tons of lead, and 4,000 lbs of silver. The total quantity of silver produced in Russia from 1704 to 1851 was 4,348,760 lbs. Although the silver mines are not adequately developed, from the large quantities already obtained, and the favorable localities for working, it is anticipated that these mines will become more valuable when further explored, and productive of great benefit to the surrounding districts.

IMPROVED REDUCTION OF LEAD ORES.

Mr. W. J. Cookson, of New-castle-on-Tyne, has secured a patent for reducing lead from the ore, by using metallic iron, oxide of iron, or iron pyrites, in smelting; whereby the sulphur in the ore combines with the iron, and is thus saved for use in the arts, the metal, by the subsequent separation of the sulphur, being reduced to a state to be again employed in reducing fresh lead ore.

COALS AND COLLIERIES.

ANTHRACITE COAL TRADE FOR 1855.

Shipments from Port Richmond to January 27th,	76,280 tons.
Last year,	66,753 "
Increase,	9,527 "

By Reading Railroad to February 1st, . .	213,151,12	tons.
Same time last year, ...	190,164,10	"
Increase, ...	22,987,02	"

STATISTICS OF THE ANTHRACITE TRADE.

We are indebted to the editor of the *Pottsville Miner's Journal*, for the annexed report of the coal trade for 1854. We insert the details at some length. We hope at an early day to furnish similar reports from the other coal districts of the country.

The following is the official quantity of anthracite coal, shipped from the different regions in Pennsylvania, during the year 1854, together with the quantity of semi-bituminous coal shipped from Dauphin County, in comparison with the supply of 1853, from the same sources:—

Schuyl. region.	1853.	1854.	Inc.	Dec.
By railroad,	1,582,248	1,987,824	405,606	
" canal,	888,695	907,354	18,659	
Pine Grove,	80,660	91,462	10,802	
Schuyl. total,	2,551,603	2,986,670	435,067	
Lehigh region,	1,080,544	1,246,418	165,874	
Del. & Hud. Co.,	494,209	440,944		53,265
Penn. coal Co.,	512,777	496,648		16,129
Wilkesbarre,	442 511	492,689	50,178	
Shamokin,	15,500	63,500	48,000	
	5,097,144	5,726,869	699,119	69,394
Wiconisco,*	69,007	57,500		11,507
Dauphin Co.,*	29,000	63,000	34,000	
	5,195,151	5,847,369	733,119	80,901
			80,901	
Total increase in 1854, ...			652,218	

Of this increase Schuylkill County furnished 435,067 tons, and the other regions 217,251 tons. Of the aggregate supply furnished, there was derived from Schuylkill County,—

	2,986,670	tons.
From all other regions, . . .	2,860,699	"
Total supply in 1854, ...	5,847,369	"

The total supply of coal from all the different regions in Pennsylvania since the commencement of the trade in 1820, amounts to,—

	48,907,860	tons.
Of this quantity, Schuylkill County furnished,	25,190,604	
Leaving supply from all others, . . .	23,717,256	"

The mining capacity of this region for producing coal, is considerably ahead of the ability to transport it to market—and the increased supply that can be furnished this year, will depend in a great measure, upon an early demand, and the regularity of that demand during the season.

* Semi-Bituminous.

COAL OPERATORS.

The following gives the quantity of coal mined and shipped by each operator, and firm in Schuylkill County, during the year 1854:—

	No. of collieries.		Total tons.
R. Heckscheer & Co.	4	136,255	
E. Borda,	1	71,688	221,684
David Glover,	1	18,741	
Chas. Miller & Co.,	5	98,907	
Adams & Miller,	1	30,514	148,[illegible]87
George M[illegible]er,	1	18,966	
Brown & White,	1	91,993	121,350
D. P. Brown & Co.,	2	29,357	
J. & R. Carter,	4		108,445
Wm. Milnes Jr. & Co.,	1		107,311
Rogers, Sinnickson & Co.,	4		103,885
R. Jones,	3	57,632	
Geo. Mason & Co.,	2	34 831	99,945
Frank Spencer,	1	7,482	
Richard Kear,	2		92,392
Gideon Bast & Co.,	3		91,028
9	35		1,095,427
Jones & Cole,	2		68,905
Wm. & Thomas Johns,	1		61,941
George W. Snyder,	2		60,813
Kirk & Baum,	1		55,299
Gordon, Bedell & Co.,	1		53,075
R. H. F. Horton,	1		52,331
W. Y. Agard & Co.,	2		52,208
Heaton & Carter,	1		51,554
George S. Repplier,	1		51,251
R. Ratcliff & Co.,	2		50,307
George H. Potts,	2		50,178
20	51		1,703,[illegible]9
William Donaldson,	1		44,748
E. W. McGinnes,	1		41,671
William Levan,	1		40,832
Peter Bowman,	1		39,755
F. Macdonald,	1		38,696
J. B. McCreary,	1		38,693
George Wiggan & Son	1		38,639
J. Doherty,	2		36,938
A. Silliman,	1		36,366
Beatty, Thomas & Co.,	1		31,839
L. S. Spangler,	2		31,285
Wallace Rothermel & Co.,	2		29,804
Samuel Sillyman,	1		28,618
Dolbin & Rogers,	1		28,535
John Tucker,	1		27,576
F. J. Parvin,	1		27,306
James Neill,	1		23,997
T. H. Schollenberger,	1		23,399
Meyer & Sillyman,	1		22,830
Sutton & Wright,	1		22,395
Daniel Edwards,	1		22,060
Connor & Roads,	2		21,680
C. J. Dobbins,	1		20,717
41	78		2,421,665
Kitzmiller, Stees & Co.,	1		18,[illegible]
H. Guiterman & Co.,	1		18,123
Wheeler & Miller,	1		17,915
John McGinnis & Co.,	1		17,748
T. I. Atwood & Co.,	1		17,[illegible]

	No. of collieries.	Total tons.
McFarland & Verner,	1	17,628
Jeremiah Reed,	1	17,205
O. F. Moore,	1	17,169
Titus, Alton & Co.,	1	16,194
John Stanton & Co.,	1	15,[illegible]91
T. H. Winstersteen,	1	15,334
John C. Neville,	2	15,125
Hammitt & Co.,	1	13,456
Jenkins & Williams,	1	13,126
Henry C Harper,	1	13,[illegible]49
T Garretson & Co.,	1	13,127
W. & C. Britain,	2	12,292
Hammer & Mile	1	11,883
Johanan Cock ll,	1	11,792
Thomas Wren & Co.,	1	11,127
George Spencer,	2	10,723
Schultz & Brother,	1	10,160
63	103	2,747,000
Thomas Gorman,	2	9,923
L. C. Dougherty,	1	[illegible],71
H. J. Osterman,	1	9,932
J. G. Hewes,	1	8,990
J. Walsey, jr.,	1	8,370
McCormick & Clark,	1	6,590
J. B. Williams,	1	6,563
W. Montelius,	1	6,533
James Burey & Brother,	1	6,510
A. Steinberger,	1	5,544
Fritz & Seltzer,	1	5,202
W. Littlehales,	1	5,013
Edward Pugh,	1	4,880
Bury & Brooke,	1	4,742
Morgan Brace,	1	[illegible],533
E Collahan,	1	4,094
Capewell & Dovey,	1	4,037
H. J. Beachem,	1	3,964
Allen & Compson,	1	3,848
Edward Davis & Co.,	1	3,305
A. B. Jackson,	1	3,769
J. S. Struthers,	1	3,574
Frantz Diehl & Co.,	1	2,817
Salem Hill Mining Co.,	1	2,814
R. Holman & Co.,	1	2,677
Fisher & Co.,	1	2,363
M. Murphy,	1	2,239
Isaac Ebert,	1	2,050
L. O'Brien,	1	2,033
Messrs. Rorer,	1	1,625
Molley & Newcomer,	1	1,491
M. Cummings & Co.,	1	1,513
P. J. Laux,	1	1,336
R. Williams & Co.,	1	1,005
Pass & Temple.	1	969
Fegley & Rohrer,	1	967
Thomas Jones,	1	959
Robert Lein,	1	[illegible]
Michael Riley,	1	819
Bechtel & Miller,	1	526
J. T. Schoener & Co.,	1	418
104	145	

From the above it appears that there were 104 individuals, and business firms engaged in mining coal during the year. The collieries worked number 145. Nine establishments mined upwards of *one million tons of coal*, and 20 mined and shipped 2,703,289 tons, which is considerably over the half of the whole supply of 1,986,670 tons, sent to market in 1854. Sixty-three operators shipped upwards of 10,000 tons.

DONALDSON, TREMONT, AND WOODVILLE COAL TRADE FOR 1854.

The coal sent from this region was mined by the following persons, as reported by the officers of the Swatara Railroad Co., as having passed over that road:—

	Pinegrove. tons.	Mine Hill. tons.	Total tons.
R. H. F. Horton,	28,536, 14	23,772 15	52,309 09
L. S. Spangler & Co.,	16,669 03	8,730, 06	25,399 09
McCormick & Clark,	393 01	6,197 15	6,590 16
Brown & White,	2,818 01	———	2,818 01
Fisher & Co.,	1,839 00	———	1,839 00
Laux & Co.,	1,335 11	———	1,335 11
Fegely & Roher,	943 09	13 11	957 00
Bechtell & Miller,	526 10	———	526 10
Gordon & Biddell, (Woodville),		53,074 00	53,074 00
	53,061 09	91,788 07	144.850 05
Increase over tonnage of 1853,			25,139 00

All the above are taken out above water level.

New and extensive collieries are about to be put into immediate operation on the Donaldson Coal Estate. One, a slope, with one sixty and two twenty horse engines, has been sunk the past season, by R. H. F. Horton, on the Mammoth vein, from the bottom of which four other veins, making in all 70 feet of coal, will be reached by tunnels, north and south. These veins are now worked by Mr. Horton, from a tunnel above water level. Another colliery will soon be in working order, by Messrs. Fisher & Co., at Tremont, and also another extensive colliery, on Raush Creek, on the same estate; and another one, by Mr. Heil, on the coal estate of Hon. Henry K. Strong, of Philadelphia.

LITTLE SCHUYLKILL COAL TRADE.

The coal sent from this portion of the Schuylkill Region in 1854, was shipped by the following Operators:—

Operators.	No. Col.	Tons.
Jno. & Richard Carter,	2	109,445 00
Heaton & Carter,	1	51,553 13
Robert Ratcliff & Co.,	2	50,306 12
Wm. Donaldson,	1	44,748 06
Jones & Cole,	2	68,904 12
George Wiggan & Son,	1	38,639 05
Peter Bowman,	1	39,754 13
Wm. Levan,	1	40,831 19
Total,		444,184 00
Total quantity sent in 1853,		389,295 04
Increase in 1854,		54,888 16

This region continues to increase and prosper. The shaft commenced by Mr. William Donaldson about two years ago, has reached the coal—it is 360 feet in depth, and 300 feet below the water level. The vein is 25 feet thick at the bottom of the shaft. The engine erected is 60 horse power. This colliery will be ready in the spring, and will be capable of turning out about 300 tons of coal per day.

William Levan has sunk a slope at the Sharp Mountain, on the Lehigh Coal Company's lands, and erected a 60 horse power engine for pumping, and breaking coal. This colliery will be ready about the first of June.

Messrs. Jones & Cole, also, are driving a tunnel in the Sharp Mountain at Reevesville.

DAUPHIN AND SUSQUEHANNA RAILROAD AND COAL CO.

The following is in round numbers, the business of this *Company in coal* for 1854:—

	*East.	†West.	Total.
Mined and shipped by the Dauphin and Susquehanna Coal Co., from their own mines,	45,000	18,000	63,000
Mined by others, and transported by the motive power of the Dauphin Company, under a lease of the Union and Swatara Railroads, branching at Pinegrove, -	29,000	1,000	30,000
Total coal of Dauphin road, - -	-	-	93,000
Hauled by Dauphin Co., over the Union and Swatara Railroads, to the Union Canal Landings, at Pinegrove, - -	-	-	- 50,000
Total coal handled by the motive power of this Company, - - -	-	-	143,000

DISTRIBUTION OF THE COAL.

The following is the distribution of the coal sent by canal and railroad during the year:—

	Railroad.	Canal.
On the line, - - -	283,212	160,940
Philadelphia, - -	292,908	175,324
Shipped from Richmond, - -	1,411,734	
Sent beyond Philadelphia, -		571,081
Total tons, - - -	1,987,854	907,354

ASHLAND COAL TRADE.

As every trade must have a beginning, we chronicle the first shipments of coal made from the Ashland Region. The quantity was sent as samples of the coal produced. If the shipments were *small* in 1854, the different operators are *big* in faith:

	Tons.	Cwt.
G. Bast & Co., - - - - - - -	8	19
Col. J. J. Connor, - - - - - - -	4	12
Bancroft & Co., - - - - - - -	3	17
Tons,	17	08

LORBERRY CREEK COAL TRADE.

There were but three operators in this region in 1854, as follows:—

	Tons.
Kitzmiller, Stees & Co., - - - - - -	18,995
Wheeler & Miller, - - - - - - -	17,915
Molley & Newcomer, - - - - - -	1,491
Total in 1854, - - - - - - - -	38,401

Increase in 1854, 10,859 tons.

Messrs. Molley & Newcomer are opening two extensive collieries in this region, and the shipments will be increased considerably hereafter.

* *East*, chiefly delivered at Auburn. † *West*, chiefly delivered at Dauphin.

LEHIGH COAL TRADE.

The coal sent to market from the Lehigh Region in 1854, was derived from the following places. We give the trade of 1853 also:—

	1853. Tons.	1854. Tons.
Summit Mines,	393,255	413,049
Room Run,	83,721	92,138
East Lehigh,		10,781
	476,976	515,918
Beaver Meadows,	55,997	54,203
Spring Mountain, (Milnes),	135,137	147,745
Colerain, (Ratcliff & Co.)	58,012	85,847
E. Sugar Loaf, (P. & Carter),	30,351	60,623
N. Y. & Lehigh, W. Taggart),		15,422
German Coal Co.,		4,022
A. Lathrop, (Pea Coal),		694
Hazleton Coal Co.,	124,250	144,216
Cranberry Coal, (Pardee),	51,217	68,899
Diamond,	44,914	43,481
Buck Mountain Co.,	77,457	66,617
Willkesbarre,	26,235	39,232
	1,080,544	1,246,418
		1,080,544
Increase in 1854,		tons 165,874

The increase from the Lehigh would have reached 200,000 tons, had not a freshet occurred in May, which checked the shipments considerably. The shipments from this region are limited for the want of facilities, for transportation on the Delaware Division of the Pennsylvania Canal. When the railroad, now making from Easton to Mauch Chunk, is finished, the trade of these regions will be largely increased.

The quantity of coal which arrived at Bristol, and cleared from other places was as follows:—

In 1852,	555,742 tons.
" 1853,	440,500 "
" 1854,	523,628 "

SHAMOKIN AND WILKESBARRE REGIONS.

We endeavored to procure the quantity of coal shipped by the different operators in 1854, from the Shamokin and Wilkesbarre Regions, but failed. We give those we have received:—

SHAMOKIN.

	Tons.
Cochran & Peale,	19,640
Kase & Reed,	15,000
Neal McArthur & Co.,	2,500
Ayres, Lewis & Co.,	250

PITTSTON COAL TRADE.

	Tons.
Pennsylvania Coal Co.,	496,648
Morganville Mines, by D. Blanchard,	18,000
James Freeland,	17,000
Polen, Brown & Co.,	20,000
J. McFarlane & Co.,	24,000
Pittston Coal Company, about	15,000
D. P. Fuller & Co.,	18,000

	Tons.
A. Price,	31,000
J. Bowkley & Beyea,	20,000
Samuel Holland, Pt. Blanchard, about	18,000
Lyshon & Brother, " " "	20,000
H. B. Hillman, " " "	10,000
Sterling & Cassidy, " " "	5,000
Gould Norton & Co., " new colliery, "	3,000
David Lewis, Plymouth,	24,000
W. Lee & Co., Nanticoke,	35,000

All the above coal was shipped by canal, except the supply furnished by the Pennsylvania Coal Company, which was sent over the mountain to Hawley, and shipped by the Delaware and Hudson Canal to market.

The Wilkesbarre Basin produced a little rising *one and a half million tons of coal in* 1854.

EASTERN PORTIONS OF SHAMOKIN AND MAHANOY COAL FIELDS.

The improvements in progress in the eastern portion of the Shamokin and Mahanoy Coal Fields, are as follows:—

Green Ridge Improvement Company.—One breaker completed—four gangways, each 10 to 15 feet—two of them leased with the breaker, &c., to Ayres, Lewis & Co., and two to make another colliery. Twenty miners' houses completed, blacksmith shop, carpenter shop, &c. Two thousand acres of land.

Coal Mt. Improvement Company.—One thousand acres of coal land, and one thousand acres of timber land. One breaker commenced, several gangways begun, six or eight dwellings finished. *President*, Jos. S. Hough.

Probst Tract.—Lessees, Fegley, Cleaver & Co. Five hundred acres. Small breaker commenced, and veins opened. Owned by Judge Helfenstein, but lately deeded in trust with other tracts for the poor, to endow the College at Shamokin, and for Colonization.

Locust Gap Property.—Two thousand acres, lately purchased by a new party, and company to be organized. Several veins opened, and dwellings begun.

Coal Run Improvement and Railroad Co.—Three thousand acres coal land and fifteen hundred acres timber land. One colliery in progress near Mt. Carmel. Breaker raised and machinery mostly on the ground. Tunnel driven 150 to 200 yards. One vein seven feet thick cut through, and three others to be reached. Twenty-four miners' dwellings finished. Two collieries in progress near Shamokin, and twenty-four dwellings finished. Railroad in progress from Mt. Carmel to Catawissa Railroad, twelve miles in length. Grading half completed. *Engineer*, John C. Trautwine.

Locust Mt. Coal and Iron Company.—Six thousand three hundred acres of land, partly in Shamokin, and partly in Mahanoy basin. Six collieries in progress, three in Shamokin basin, and three in Mahanoy. In the Shamokin basin are,—

The Coal Ridge Colliery.—Completed, breaker, and double set schutes, thirty horse engine, blacksmith and carpenter shops. Three veins opened, each from twelve to eighteen feet; five hundred yards of gangway driven. Lessees, Henry Eckel & Son.

The Red Ridge Colliery.—Four veins proved (four, nine, eighteen and six feet thick), and tunnel driven 140 yards.

The Locust Mountain Colliery.—Two veins proved, eighteen and twenty-two feet thick. Tunnel driven 120 yards.

For the accommodation of these three collieries, sixty-five dwellings have been built, about half a mile east of Mt. Carmel, and the place designated Stuartville, in respect to George H. Stuart, one of the directors.

The three collieries in the Mahanoy basin are,—

The Big Mine Run Colliery.—Worked by G. Bast & Co. The breaker and schutes are nearly finished; two sets of breaking rolls, three 25 horse engines for hoisting and breaking. Vein 28 feet thick; 150 yards of gangway driven. Twenty-four miners' dwellings, saw-mill, &c. Will be ready for business by the opening of the Mine Hill railroad in the spring.

The Locust Run Colliery.—Worked by George S. Repplier & Co. Nearly completed. Large breaker and schutes, and thirty horse engine for breaking. Tunnel driven 150 yards; two veins cut, 200 yards gangway driven; thirty miners' dwellings, carpenter and smith shops, steam saw-mill, &c.

The Big Run Colliery.—Breaker and schutes nearly finished. Tunnel driven 70 yards; vein cut 27 feet thick, and twenty-four dwellings for miners.

The Ashland Estate.—Owned by Messrs. Brock & Co., has some five or six collieries in progress. Among them Messrs. Bancroft & Co.'s, finished; Col. J. J. Connor's, W. DeHaven's, and Mr. Atkins's; breakers and schutes up, and gangways driven considerable distances. About 150 houses built for the accommodation of miners and laborers.

NUMBER OF CANAL BOATS AND THEIR CAPACITY, &C.

The number of coal boats running on the Schuylkill Canal is 700, average capacity 150 tons. Maximum capacity 200 tons. This statement does not include several Union Canal boats running.

On the Lehigh, Morris Canal and Delaware Division, there were in 1854, 1916 boats employed. On the Morris Canal, the average capacity is 59 tons. On the Lehigh and Delaware Division, 70 tons.

The Delaware and Hudson Company had 400 boats running last year, average capacity, 115 tons.

The Pennsylvania Coal Company had 500 boats running, average capacity, 120 tons.

On the North Branch Canal, there are about 1000 boats running, Flat-bottoms and Shawnee boats carry 68 tons; Tide-water 62 tons; Juniata boats, 54 tons; Union, 28 tons; Old Schuylkill, 45 tons; average capacity of all, 58¼ tons.

RECAPITULATION.

	No. bts.	Av. capac.
Schuylkill Canal,	700	150 tons.
Lehigh,	1916	68 "
Del. & Hud. Canal,	900	118 "
North Branch Canal,	1000	58¼ "
Total,	4516	

Giving 4516 canal boats engaged in carrying coal to market in 1854, on the different canals.

DELAWARE AND RARITAN CANAL.

The canal boats engaged in carrying coal through this canal in 1854, were as follows:—

	No. bts.	Av. capac.
From the Schuylkill,	298	170 tons.
" Lehigh,	286	71 "
" Richmond,	228	190 "
" Bristol,	110	170 "
Total boats,	922	

LATERAL RAILROADS.

Official quantity of coal transported by the different lateral railroads in Schuylkill County in 1854, together with the increase over last year:—

	1854.	Increase.
Mine Hill & S. Haven,	1,227,805	178,387
Schuylkill Valley, . .	542,861	69,577
Mill Creek, ...	486,622	34.809
Little Schuylkill, . . .	444.184	54.489
Mount Carbon, ...	189,066	40,336
Swatara, ...	53,062	213
Lorberry Creek, ...	38,401	10,590
	2,982.001	
Mt. Carbon & Pt. Carbon,	658,078	120,581
Union Canal, ...	91,462	10,802

The coal transported over the Mount Carbon and Port Carbon Railroad, was received from the Schuylkill Valley and Mill Creek Railroads, and the coal transported over the Union Canal Railroad, was received from the Swatara and Lorberry Creek Railroads. The tonnage, it will be observed, was increased on every railroad in the county, in 1854.

NUMBER OF OPERATORS, COLLIERIES, &C.

We give the number of operators and collieries, together with the number above and below the water level, in the different sections of the region. Some of the collieries designated as *below* are also worked above the water level:—

	Oper.	Col.	Ab. wat. lev.	Be. wat. lev.
West Branch,	42	50	21	29
Schuylkill Valley,	29	33	18	15
Mill Creek,	19	22	11	11
Mount Carbon,	14	16	10	6
Little Schuylkill,	8	13	5	8
Tremont,	7	8	8	
Lorberry Creek,	3	3	3	
	122	145	76	69

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CUMBERLAND COAL REGION.

The shipments for 1854, from the Cumberland Region, will be found elsewhere in this Number.

There are twelve regularly organized coal companies in the Cumberland coal field, which mine or own lands containing the 'big vein.' These are severally styled the Cumberland Coal and Iron Company, George's Creek Coal and Iron Company, Hampshire Coal and Iron Company, Withers Mining Company, Alleghany Coal Company, Borden Mining Company, New-York Coal Company, Frostburgh Coal Company, American (formerly Parker Vein) Coal Company, Caledonia Coal Company, Phenix Coal Company, and Swanton Coal Company. The New Creek and Llangollen Companies' lands, do not contain the 'big vein,' and their operations are confined to one of the smaller veins, commonly called the 'six foot vein.'

The Companies in the region mining the 'big vein,' that have connections between their mines, and the Baltimore and Ohio Railroad, by lateral roads owned and controlled by themselves, are the Cumberland, George's Creek, and Hampshire Companies, the three first named. All the others are lateral roads, controlled by mining or manufacturing companies disconnected from them.

ORDERS, RULES, AND REGULATIONS TO BE OBSERVED BY THE WORKMEN,

And all others concerned in the working of the CASTLE EDEN COLLIERY, *the property of the Castle Eden Coal Company.—England.*

UNDERGROUND.—GENERAL RULES.

1. No person is allowed to go down the pit without orders from the viewer (except workmen at the proper times fixed), and it is the duty of the banksmen (or the brakesmen in the absence of the banksmen) to see that this rule is attended to, whose duty it also is, in particular, to see that no workmen or other person goes down the pit in a state of intoxication. Any person obstructing the banksmen or brakeman in enforcing this rule is liable to a fine of 2s. 6d.

2. The overman, or deputy, to go round each pit every morning before the hewers or any other persons proceed inbye, to ascertain that the mine and working places are in a safe working order and condition, and no workman is allowed to descend the pit or proceed inbye before the overman, or deputy, or into his place before its having been examined by one of them and pronounced to be safe.

3. Should a working place, or any part of the mine be found to be in an unsafe state, the overman, or deputy, is immediately to set a prop in the middle of any such place (between the rails) a sufficient distance from the point of danger, beyond which no person is allowed to go; and a prop being so placed to be considered in all cases as a signal of danger in any person going beyond it.

4. No person is allowed under any pretext whatever to work in any place without a safety-lamp, where there is the least appearance of fire-damp; nor is any person allowed to work in an admixture of carbonic acid gas or styth; and should a sudden emission of explosive gas make its appearance in any place where a man is pursuing his work, he is immediately to retreat and give notice to the overman, or deputy, in charge of that department of the mine.

5. A barometer and thermometer to be kept in the colliery office, at all times accessible by the overman, inspector, deputies, and other persons in charge, for the purpose of indicating the state of the atmosphere, for it will generally be found that as the barometer falls and the thermometer rises (and in south or south-east winds it is the most dangerous) the greater will be the flow of gas into the mine, and consequently more caution is necessary on the part of the overmen, and every other person in charge. Although the barometer is a pretty sure indicator of the gaseous state of the mine, too much dependence must not be placed upon it, because, for instance, on an inspection of it by an officer on going down the pit, it may indicate the comparative absence of gas in the mine, and by the time he proceeds inbye a sudden change may take place in the state of the atmosphere, and the mine may be in a very different state to which he expected to find it.

6. No person is allowed, under any pretext whatever, to go into any part of the mine, except where he is ordered by the overman, deputy, inspector, or master wasteman, or where his work requires him.

7. Each deputy is to set a sufficient quantity of timber for supporting the roof in every part of the workings and working places under his charge, and renew it as often as necessary; but should a place, in course of working, require additional timber in the absence of the deputy, the hewer is not to continue his work, but to send for the deputy, and leave his place until such additional timber is set.

8. Each deputy to brattice all places under his charge. The brattice to be in no case further back from the face than 6 feet.

9. It is the duty of each deputy (who has in all cases to attend to the orders of the underviewer and overmen), to put in all bord-end brattice, where required, in the district of workings under his charge, also to set all doors, where necessary for the full and effectual ventilation of the mine, and the un-

der-viewer to order and see that all stoppings are built of stone and brick, where necessary, and properly plastered.

10. All timber, &c., in the back pillars not to be drawn, except with a safety-lamp.

11. All doors, for the purposes of ventilation, to be so placed and hung, that they will not stand open of themselves, and any person interfering with a door (except his opening it to go through), or leaving it otherwise than shut, is liable to a fine of 10s., or to be taken before a magistrate, at the option of the owners or viewer. One moiety of the fine to be paid to the informer.

12. The deputies are at the close of each day's work to see the whole of the men and boys out of their respective ways and districts, and before leaving it themselves they are to see that no lights are left in, that the doors are closed, and that the ventilation is going on properly.

13. The under-viewer to apportion to each deputy the district and number of working places to be taken charge of by him.

14. It is the duty of the deputies, in the absence of the overmen and inspectors, to see that these rules are attended to, that the workings of the mine is properly conducted, and that the hewers work their places according to orders, or to report to the overman any one acting to the contrary.

15. The overmen to go round the pits on the Sunday mornings, and every other morning that the pits may not be at work, to ascertain that the ventilation is going properly on, and that the pits are in a safe state.

16. The master-wasteman to examine the wastes daily, both with respect to the state of the air-courses and the quantity of air passing, and report to the under-viewer the result of such examination. He is to see that the different currents of air are going in their proper channels, and to travel so much of the waste each day (accompanied by another person) as he can accomplish, so that the whole be travelled at least once in every week. He is to see that the waste is properly ventilated, that there are no obstructions in the different air-courses, and that both the principal returns and the courses are kept in a proper state, and of a sufficient area for the full and effectual ventilation of the mine.

17. The under-level drifts to be regularly examined by the master wasteman, whose duty it is to see that they are at all times kept in a proper state and open, so that the water has a free passage to the engine. He is to see that the mine is regularly and effectually drained of water, or report the same to the engineer.

18. Any workman receiving an injury requiring the aid of the surgeon, is to be got home with all possible speed, and the surgeon is immediately to be sent for.

19. The overmen to regulate, at the commencement of each day, the workings of the different ways in each pit, and the quantity of coals to be worked by each man, so as to equalize as nearly as possible the earnings of the hewers.

20. The day's work of each pit to consist of 12 hours, and to commence from the drawing of the first coals.

21. Not more than eight persons to descend or ascend the shaft at one time, and no person is allowed to descend or ascend on the cage top, or with or against the laden or empty tubs. The banksman to attend the shaft when the men and boys are going down before the pit hangs on, and to remain in attendance upon the shaft after the pit is done until all the men and boys are out of the pit.

22. Not more than three men or four boys are allowed to ascend or descend the "polka" staple at one time, and no man or boy is allowed to descend with a full tub.

23. The cages used for drawing the coals, and in which the men descend and ascend the shafts, are to be inspected daily by the engineer, as also the chains attached thereto, and it is the duty of the banksmen (in the absence of the engineer), in case they should see any defect, to report the same to him,

in order that it may be rectified. No cage to be used on which there is not a cover of sheet-iron.

24. The shaftman to examine the shafts every day to see that the conductors for the cages and the shafts generally are in a proper state. If fonnd to the contrary, to report the result of his examination to the engineer, who is to see that the same is rectified. The shaftman to see that there is a constant and regular supply of water on the brattice in the up-cast shaft, in order that it be kept in a damp state.

25. The furnace-drift to be cleansed from all soot and other accumulations once every fortnight; and it is the duty of the master-wasteman to see that it is done. He is also to travel the air-ways on each side of the furnace every day.

26. Not less than three persons to ride at one time during coal work (unless no coals are out), and any person obstructing the onsetter in enforcing this rule, is liable to a fine of 6d.; but any man may ride alone after waiting 10 minutes.

27. No hewer, or other workman, is allowed to ride in or outbye, and any one found offending against this order is liable to a fine of 6d.

28. Swearing is not allowed in the mine, and any one offending against this order is liable to a fine of 6d.; and any one striking at, or otherwise ill-treating another, or being the cause of any disturbance in the mine, is liable to a fine of 2s. 6d., or to be taken before a magistrate for the offence.

29. No boys are allowed to work in the mine under 10 years of age, and any parent sending his or her child to work under that age, or falsely representing his age, is liable to be fined by Act of Parliament.

30. Any one obstructing the account keepers in their duty, by interfering with the account of the hewer's and putter's works, or striking at them, or otherwise ill-treating them, is liable to a fine of 2s. 6d.

31. No ale or other intoxicating drink is allowed under any pretext whatever to be taken down the pit, and any person disobeying this order is liable to be fined.

32. Any person leaving a lighted candle, or any other light, in any part of the mine, is liable to a fine of 10s.

33. No lucifer-matches are, under any pretence whatever, allowed to be taken down the pit.

34. Any workman working shift-work is to be the required time (8 or 12 hours, as the case may be) in the face or at the place of working; and the furnace keepers, in particular, are to change at the furnace, or if they are found disobeying this order, or the orders of the underviewer, or other person in charge, in keeping the furnace, they will be liable to a fine of 2s. 6d., or to be taken before a magistrate for the offence.

35. Every workman is held responsible for the work tools, or other property of the company intrusted to him, until the same are delivered to the person in charge, from whom he received them.

36. The hewers to use their utmost endeavors in working the coal, to produce as much merchantable round coal as the nature of the mine will admit, and keep the same free from stone, band, slate, splint, or foul coal, and if any tub be sent to bank containing six pounds or more of stone, band, slate, splint, or foul coal, no payment shall be made for hewing and filling the same.

37. The hewers are to work the different seams according to the plan and in the manner ordered by the owners or their agents, and they are to stow away such quantities of small or refuse coals as the owners or their agents shall require, and are to do the business of the drivers, and set on tubs when it shall be requisite; and the hewers and drivers are, when required by the owners or agents, to put with trams or act as barrowmen.

38. Any tub which shall be sent to bank suspected to be deficient in weight shall be weighed by the heap-keeper or other person appointed for that purpose by the owners, and if found deficient no payment shall be made for hewing, filling, and putting the same, but the hewer thereof shall not be subject

to any forfeiture or penalty on that account. The standard weight to be 7½ cwt., or 840 lbs. No tub weighed for the average weight to be set out, and no set-out tub to be included in the average weight.

39. The hewing price to be paid to each hewer in proportion to the weight of coals he may send to bank (7½ cwt. being considered as the standard for the fixed price), and in order to ascertain each man's separate weight, a person, to be appointed by the owners, shall weigh a number of tubs not exceeding five per day for each man, the average of which for the fortnight to be the weight upon which he shall be paid. As an inducement for the hewers to produce as many round coals as possible, an allowance of 28lbs. to be made on each tub weighed, consisting entirely of merchantable round coals. Any tub weighed that shall on being teamed be found to contain a pick, or picks, the same shall not be included in the average weight. A person appointed by the men may attend the weighing of the tubs and keep an account thereof.

40. Any hewer not performing, when required, except when prevented by sickness, or other sufficient unavoidable cause, a full day's work on each and every working day, or such a quantity of work as shall be fairly deemed equal to a day's work, not exceeding eight hours, or leaving his work until such day's work, or quantity of work, is fully performed, and finished to the extent of his ability, is liable to a fine of 2s. 6d. for every such default, or be taken before a magistrate for the offence.

41. Any putter not putting away, or any driver not duly driving or leading away, except when prevented by sickness or other sufficient unavoidable cause, such a number of tubs of coal as shall be a reasonable and fair day's work, such day's work to consist of 12 hours, and to commence from the drawing of the first coals, is liable to a fine, the former of a sum not exceeding 2s. 6d., and the latter of a sum not exceeding 1s. for every such default, or to be taken before a magistrate for the offence.

42. Each hewer to be provided with a rake, shovel, maul, and wedges, by the owners, for which he is accountable; and he is to provide himself, at his own charge, with picks, drills, powder, and candles.

43. Each workman for whom a dwelling-house or room is provided by the owners, shall keep in good repair the glass in the windows thereof, or pay the owners for the repairs of the same; such dwelling-house or room being occupied as, and for part of the wages of the occupier, who is not deemed the tenant thereof, and who shall forthwith quit the same on his ceasing to be the servant of the owners, and in case he and his family, or any other person who shall be in possession thereof with his consent, shall refuse to do so, it shall be lawful for the owners, or their agents and servants, or any of them, to enter into and upon such dwelling-house or room, and to remove or turn out of possession every person occupying the same, and all furniture and effects therein.

44. Any underground workman leaving his employment before the expiration of a calendar month's notice to be given, or received, by him, shall forfeit all wages that may then be due to him, besides being liable to the laws now in force, for the regulation of masters and servants.

45. The under-viewer to examine the mine every day, and in addition to his own personal inspection of the state of the workings and operations carried on therein, the waste, the state of the air courses, and quantity of air passing in the different currents, the ventilation, and the state of the mine generally; he is to receive a daily report from the overmen and master-wasteman of the state of the mine, and the workings and operations under their charge. Should he find any defect or irregularity in the ventilation of the mine, or in the operations carried on therein, or should he find any part of the mine to be in an unsafe condition, he is immediately to order proper steps to be taken to remove the same, and to see the same carried into effect. He is to report to the viewer from time to time upon the state of the mine generally, and immediately when he finds it otherwise than in a safe state, or the operations not conducted properly and according to these rules. He is to report to the

viewer any accident that may take place, so that the cause of it may be inquired into, in order that any person who may be to blame may be punished, and that proper steps may be taken to prevent, if possible, a similar occurrence in future.

(To be continued.)

THE COAL FIELDS OF GREAT BRITAIN.

As our various national resources have continued to increase in vigor and magnitude, and industrial enterprise has daily become more and more largely developed, so, in a perpetually increasing ratio, has been the drain, so to speak, on the precious deposits of our great carboniferous store-houses—in fact, the consumption of coal at the present period is altogether unprecedented. Not less than 37,000,000 tons are now annually raised to meet the demand in various quarters. The value of this vast mass of the mineral extracted from the bowels of the earth by the labors of about 160,000 persons, is at the pit's mouth little less than 10,000,000*l*., at the places of consumption, including expenses of transport and other charges, probably not less than 20,000,000*l*. The capital employed in the trade exceeds 10,000,000*l*. London alone consumes upwards of 3½ millions of tons annually—about half a million of which are now brought by the Great Northern Railway; and as a proof of the rapidly increasing consumption, a metropolitan return, which has recently been issued, shows that, in 1853, there were 3,745,345 tons brought into the port of London, against 3,490,993 tons of the preceding year. In 1850, our coasting vessels conveyed upwards of 9,360,000 tons to various ports in the United Kingdom; and 3,350,000 tons were exported to foreign countries and the British possessions. Of these, France took 612,545 tons; Holland 159,953 tons; Prussia, 186,528 tons, and Russia, 235,198 tons. Our ocean steamers now require very large supplies indeed; and it is calculated that 30,000 tons will be required for the use of the Baltic and Mediterranean fleets. The consumption by our manufacturing establishments is immense; and as one isolated proof of the rapidity and extent of the increase, I may mention the fact that, in the year ending October 31st last, 113 new mills have been built in Lancashire; and the gross increase in the year, of steam power, has been 3,894 horses, requiring 15,600 additional hands.

About 400 iron furnaces of Great Britain consume annually 10,000,000 tons of coal, and 7,000,000 tons of ironstone, in order to produce 2,500,000 tons of pig iron, of the value of upwards of 8,000,000*l*.; and we must not be unmindful that these great smelting establishments, in order to meet the vast and growing demand for iron rails, houses, churches, ships, &c., are now constantly augmenting in number, which, with other demands, too obvious to particularize, will also tend to increase immeasurably the present consumption of coal.—*London Mining Journal.*

WASTE OF COAL.

Mr. Holmes, in his *Treatise on Coal Mines*, states the waste of small coal at the pit's mouth to be one fourth of the whole. The waste in the mines is computed to be one third.

REVENUE OF COAL ESTATES.

Comparatively few have an adequate conception of the magnitude and real value of the coal estates of the three great anthracite regions. In Schuylkill County, where operations have been carried on more extensively, and for a longer period than elsewhere, the revenue derived is truly astonishing. From a single tract of 200 acres, in that county, the income, since 1836, we have been informed, has averaged $18,000 per annum. This is but one of

many cases that have come to our knowledge. There are, indeed, other estates that yield even more abundantly.

In the Luzerne region, the profits that attend mining operations are equally remarkable. The Baltimore Company, located two miles from Wilkesbarre, cleared in 1853 $60,000. Their investments in lands and machinery have been but $130,000—which, therefore, is returned to the stockholders every two or three years. The Pennsylvania Coal Company, in the same region, though laboring under great disadvantages in the shipment of coal, netted the same year, $330,000. The coal department of the Scranton Company, also, during the same time, cleared a profit of $76,000 upon but 100,000 tons mined, although most of their large expenditures for development were increased during this period.

If the facts establish any thing, they show clearly that available anthracite coal lands are among the safest and most remunerative investments, and that they are not estimated "at a tithe of their positive or productive value."

MINING OPERATIONS IN LUZERNE COUNTY.

The operation in coal throughout our valley, in anticipations of the immense business to be done in its transportation next season, are becoming various and extensive.

We will enumerate some of the operations now in progress and being commenced, to give our readers some idea of the amount of business in coal, which next season will develope. First, and most extensive, are the works of the Delaware, Lackawanna and Western Railroad Company. Several new slopes have been sunk on the old Tripp track, and two new coal breakers of great size and capacity have been erected. On the Griffin farm, two slopes are in progress, and fifty miners' houses have been erected. More slopes will be added, and coal breakers with the other necessary machinery, of the largest capacity, will be put up with all possible dispatch. The Bloomsburg road is now complete to these mines, and the operations will be far enough advanced early in the season, to afford a large quota of coal for the different markets.

The works of the Iron and Coal Co., are also being very much extended. An extensive coal breaker and other machinery, to mine and prepare for market an abundant increase of coal, has lately been commenced, and is being rapidly completed.

The "Union Iron and Coal Co.," Moses Taylor of New York, President, possessing an enormous capital, and owning some two thousand acres of the best land in the valley, have commenced operations on the road just below Hyde Park, and intend, as we are informed, to carry on the business next season to a great extent.

The "Providence Coal Co.," have advertised for proposals to sink a coal shaft on their lands, back of Providence borough. This company own quite a large tract in that locality, and intend to carry on business quite extensively.

Mr. Judson Clark has lately opened a mine, and erected a small breaker, on his property near the notch of the mountain, and is doing a good business.

Mr. G. H. Coursen, of New York, has a valuable tract back of Hyde Park, upon which he is now erecting extensive works, to be ready for operation during the next season. Besides the above, many other openings are contemplated, and will, no doubt, go into active operation very soon. The demand once created, and fairly apprehended by the capitalists of our valley, works of this kind will be extended and increased, until the coal is exhausted, or the markets surfeited.—*Scranton Herald.*

COAL FIELDS OF ARKANSAS, AND NEW ORLEANS.

In an extract from the N. O. Delta, which I saw lately, I see that, in speaking of the advantages of the Louisville and Memphis Railroad to New

Orleans, you name stone-coal as one—the advantages which this road will afford to your city, in bringing coal along it at all seasons to Memphis, from which place the navigation of the Mississippi River to New Orleans, is at all times unimpeded.

Now, I admit that, under present circumstances, this is a great advantage; nor would I detract any from the importance of this road, even in this point of view—for I am and always have been a great friend to it. But there are rich and extensive coal fields, of the finest coal—both bituminous and anthracite—much nearer New Orleans than those of Kentucky—in fact, almost or quite as near again, and which can be made far more accessible. These fields seem to be very little known—in fact, scarcely any; and I wish, through the medium of your valuable and widely-circulated paper, to call the public attention to them. When at Little Rock, some two years since, I saw specimens of the coal, and can bear testimony to its existence and value.

These fields, as discovered, begin about forty miles above Little Rock, near or at the Arkansas River, as I was informed, somewhere about Johnson County, and, in *that part* of Arkansas, extend over some counties and fractions of counties. But these discoveries I take to be only a portion of the great coal-field of Arkansas, and perhaps only a small portion—the northern and north-western rim or side of the coal-basin.

Again, I see from the papers, recently, that rich and extensive mines of fine coal have been discovered about and not far from Camden, in the southern and south-eastern part of Arkansas; and when in that country—in Union County—about two years since, I was informed, on reliable authority, that mines of coal had been found below Camden, and, perhaps, in Union. This is the lower side or rim of the basin.

From these facts and data, we can see somewhat the shape, extent and direction of this great coal-field; that it begins above Little Rock, where the discoveries have been made of which I have spoken—then makes a deep dip south and south-east, under the Little Rock and Hot Springs regions and the country between—and then appears again, or "crops out" above Camden, where the late discoveries have been made. This I judge to be the shape and extent of the basin. And I think it very probable that, at a great depth below Little Rock—perhaps two hundred feet or more—there are rich beds of coal, and which the sinking of a shaft would show. The character of the country about Little Rock and Hot Springs indicates the existence of coal, I think below the surface of the country. From the former to the latter place, it is of a slaty character nearly all the way. The slate is everywhere "cropping out" on the hill sides and slopes, and to be seen in the bottoms of the streams; and at Little Rock is an extensive quarry of as fine slate as I ever saw anywhere—and which is said to extend some forty or fifty miles in a south-westerly direction. It is, no doubt, this which I crossed on my way from that place to the Hot Springs.

Now, this is the coal-field from which New Orleans must utterly draw her supplies, as well as Memphis, and the intermediate places on the Mississippi. And all that is necessary, is for Arkansas to build the roads, projected in her, to the Mississippi River, have branches to these mines, and mine the coal and send it to market.

In fact, coal could now be mined above Little Rock, in the coal regions there, and taken down the Arkansas River to New Orleans (as easily as down the Ohio), and made a profitable business; and also from the mines above Camden, and taken down the Ouachita River.

I think that I am warranted in these views of the Arkansas coal basin, from analogy. North of the Ohio, in Indiana or Ohio, are coal-fields; and then, again, in noth-western Kentucy. It was supposed the coal dipped under the Ohio at Evansville. A shaft was sunk, and, at upwards of two hundred feet, coal was found. Such is the result of geological observations.—*Correspondent New Orleans Delta.*

OBSERVATIONS ON THE COAL FIELDS OF PENNSYLVANIA.

The following interesting remarks on the coal fields of Pennsylvania are made by Prof. H. D. Rogers, as introductory to a description of numerous species of new fossil plants found there :—

The following new species of fossil plants, one hundred and ten in number, are some of the results of a systematic investigation of the fossil flora of the carboniferous strata of Pennsylvania and the adjacent coal fields of Ohio and Virginia, undertaken three years ago by my able assistant in this department of the geological survey of Pennsylvania, Leo Lesquereux, Esq., formerly of Switzerland, now of Columbus, Ohio.

By far the greater part of the specimens were collected by himself, and these are now in our possession. A few of the new species were first seen and studied by him in the rich local cabinets of Mr. Clarkson, of Carbondale, and of the Rev. W. Moore, of Greensburg, to whom our best thanks are due for their liberality in thus opening their collections for the description of what was new. Many of these hitherto undescribed forms were discovered in the slates, associated with the beds of anthracite in the coal fields of eastern Pennsylvania, which, compared with the bituminous coal measures of western Pennsylvania, appear not only to contain a greater variety of species, but to present them in a condition of more perfect preservation for study.

The new species here briefly described by Mr. Lesquereux, constitute about one half of the total number of well-defined forms hitherto detected by him in the coal measures and lower carboniferous rocks (the vespertine series) of Pennsylvania; more than one hundred of the two hundred and twenty species examined by him proving to be entirely identical with species already recognized in the European coal fields, and some fifty more of them showing differences so slight, that a fuller comparison with better specimens, may result in their identification likewise. As a further evidence of the near affinity of the North American to the European fossil flora of the carboniferous age, he has remarked, in the course of his investigations, that even these new species which seem restricted to this continent, are every one of them in close relationship with European forms. It deserves mention, moreover, that the commonest European species are likewise the most common American ones.

A stratigraphical analysis of the anthracite measures of Pennsylvania, calls for their division into two groups, a lower series, distinguished by the *white* or very pale color of the ashes of nearly all the coal seams, and an upper series, including coals as remarkable for yielding only pinkish or red ashes. Between these groups there usually exists, especially in the southern or Pottsville basin, a small transition group of two or three beds of gray ash, or pinkish-gray ash coals. The entire number of coal seams, of a thickness admitting mining, in the middle portion of the southern basin, where the whole formation is thickest and most replete in coal beds, does not exceed about twenty-five; and counting those of all dimensions, the total series does not amount to more than from thirty to thirty-five separate layers.

In the bituminous coal measures west of the Alleghany Mountains, the whole number of workable seams is less than one half of that above named, as belonging to the anthracite formation, while, including the thinner and less persistent beds, the entire series cannot there amount to more than eighteen or twenty. That portion of this great Appalachian coal field, which lies within Ohio, appears to possess even somewhat fewer than the eastern half in Pennsylvania, the beds suitable for mining being estimated at seven, and the small seams about ten, in addition.

Advancing westward to the great coal basin of Indiania and Illinois, the coals thick enough for working are counted at only six, and the thin ones proportionately few; and this remarkable progressive reduction in the coal beds, going westward, seems to be maintained as far as we advance in the forma-

tion; for crossing the Mississippi to the wide shallow coal measures of Missouri and Iowa, the number of the workable beds there believed to exist, does not amount to more than three or four. Accompanying this interesting gradation in the amount of coal, there occurs an equally noteworthy diminution in the thickness and coarseness of the associated strata, showing a progressive thinning down of the whole of the land-derived coal-bearing portions of the carboniferous deposits. A future comparison of the fossil plants of these broad successive coal basins will probably disclose a corresponding reduction in the number and variety of the species, a view already suggested by their relative paucity in the bituminous coal fields of western Pennsylvania and Ohio, as measured by their abundance in the anthracite basins.

Wherever I have studied either of the anthracite fields, of the great Appalachian basin, I have remarked that the lower or "white ash" division of the coal measures, gives indications of more violent and frequent disturbances of level in the surface, at the time of the deposition of the strata, than are noticeable in the composition of the upper or "red ash" part of the formation. Among the proofs are, more abrupt and frequent alternations of coarse and fine deposits, more diversified and rapid changes in the thickness, composition, and arrangement of the strata, both of the mechanical deposits and the life-derived beds of coal, and the far greater mutability and inconstancy of all those strata, even the most quietly deposited, within the same area or extent of outcrop. The lower strata of the anthracite coal measures are, indeed, remarkable for the diversity in the coarseness of the sandstones, and for the unsteadiness in thickness of the coal beds themselves. Though these carbonaceous layers are the accumulations of once perfectly level sea-meadows, at successive depressions of the surface, it is evident, from their comparatively rapid thickening and thinning, and frequent coalescing and diverging, that the floors upon which they were collected were neither so wide as those which grew the vegetation that resulted in the bituminous coal beds, nor so uniform and gradual and horizontal in their slow movements of elevation and depression.

Commensurate with the more fluctuating size, and more restricted range of these lower coal seams, is a greater inconstancy and diversity in their fossil flora. The more widely extended upper beds appear to exhibit a more limited specific vegetation, expanded over wider areas.

As far as our researches have gone, we notice that the lower strata, both in the anthracite measures, and in the great Appalachian coal field, abound in the larger species, especially in Lepidodendra, while the higher seams are characterized by the smaller *herbaceous species*, most generally the herbaceous ferns.

We conceive that the large proportion of species common to the coal strata of North America and Europe clearly establishes idendity of age between the two deposits, and a close accordance, if not identity, in the geographical and climatal conditions prevailing at their formation. A yet closer agreement is noticeable between the species found in the several coal fields in the United States. Indeed, so alike are all the anthracite basins in their fossils, that Mr. Lesquereux already recognizes more than twenty familiar European species as common to these once continuously united coal fields. It has been indicated above, that the two different groups of the coal strata of Pennsylvania, the lower or white ash, and the upper or red ash, are characterized by somewhat different species, though these more or less intermingle. Satisfied of this fact, of a general prevalence of certain forms in certain parts of the coal measures, we have aimed at carrying our inquiry a step farther, to ascertain whether or not any or all of the individual coal seams themselves are separately recognizable by their fossil plants. Undoubtedly, in some of the broadly deposited and uniformly conditioned coal beds and coal slates of the western bituminous coal fields, we do observe a most striking prevalence of the same species within the same layer, over comparatively wide areas; but amid the more irregularly accumulated beds, of especially the lower or white

ash anthracite strata, formed on a less stable portion of the nowhere absolutely stationary crust, the inconstancy in the vegetation of even the same coal seam is, for the most part, if not even quite, too great to permit us to attempt to identify it by its fossils merely. Again, in some instances, coal beds which are demonstrably different, are almost absolutely identical in their fossils. This is the case with the "Gate" and the "Salem" coals, near Pottsville. So strikingly alike are they in their vegetation, that Mr. Lesquereux strongly inclines to regard them as but the detached parts of originally one sheet of coal, and to suspect that there is some error of obscurity in my section, which shows them to be separated by several hundred feet of strata, including a number of beds of coal. Of the validity of the proofs, showing the so-called Salem vein, to be different coal from the Gate vein. and several stages higher in the series, there cannot, however, be any question, and the palæontological evidence for identity must give way before the higher and decisive demonstration from superposition, of their difference in age.

IRON AND ZINC.

BLACK BAND ORE.

The following is the report of Mr. A. M. Sherman, to the President of the Cumberland Coal Co., at whose request the property of the Company was examined by Mr. Sherman, relative to the existence of the Black Band Ore.

SIR:—In complying with the request to visit the mines of your Company, and ascertain the facts in the rumored discovery of valuable iron ore on the lands of the Company, I have the honor to report:—That Mr. F. Bloodgood and myself left this city on the 19th January, and arrived at the mines on the following evening; on the 22d, (Monday) we commenced our investigations. Before proceeding, however, I cannot omit to express the agreeable surprise felt on finding the "coal field," instead of a rough mountainous and sterile region, presented a gently indulating surface of rich agricultural land, beautifully diversified with patches of woodland, meadows and grain fields for miles in extent. Under this pleasing exterior lies the great 14 *foot vein of coal!*

At the foot of a hill or gentle slope, a few yards from the Company's principal depot and railroad station, accompanied by the intelligent and efficient superintendent, Mr. Henderson, we entered the "Eckhart" mine. After advancing a few yards, we entered the great vein of coal, which lies immediately on a bed of dark slate, or shale, the whole "field" presenting the singular feature of an immense trough, the centre, (longitudinally) being *curved downwards* to a considerable degree, like an inverted arch; while the surface presents no evidence of a corresponding depression.

Pursuing the main gallery, bearing to the left on a gently *ascending* grade, we examined several thousand yards in extent; and ascertaining by the frequent "falls" in the roof of the chambers and galleries, that the entire mine was covered by an overlie, or bed of dark-gray stone, resting directly upon the great vein of coal, and extending upward to the thickness of 20 feet. Immense masses of this stone had fallen in different parts of the mine, and some of the fragments from these masses were examined and found to contain *unmistakable* evidences of the presence of iron in their composition.

A convenient position was therefore chosen, where the roof in one of the chambers had fallen, forming a "dome-like" ceiling, from 12 to 15 feet high,

exposing, on its sides, a *vertical* section to that height, and affording a good opportunity of examining the material in *situe*, from which it appeared to lie in irregular and imperfectly defined strata, much divided by *seams* and extremely liable to fall (where it was not well secured by props) in irregular triangular and oblong masses, of from three to twelve inches thick; its cleavage imperfect, and fracture generally of a dark-gray (approaching to black) stony appearance with thin streaks of lighter shade, some, however, presenting a fracture of light-gray, with minute specks of metallic brightness. The density and weight of the whole being such as to induce the belief that the entire mass or "overlie" was composed of that peculiar iron-bearing stone, known as "black band;" but want of familiarity with this, to us, new kind of ore, and the extreme difficulty of determining its character from its external appearance, induced us to measure the first 20 feet and number the several strata (the markings being sufficiently distinct to afford an approximate measurement of thickness, &c.), commencing at the base or coal vein, as follows:

No. 1, one foot thick,	No. 5, five inches thick,
" 2, two feet thick,	" 6, two feet thick,
" 3, six feet thick,	" 7, two feet thick,
" 4, six inches thick,	" 8, six feet thick.

I have submitted samples of six of the above, viz.: 1, 2, 3, 6, 7 and 8, to James R. Chilton, M.D. of this city, and obtained their analysis as early as possible, the result of which you will see by his certificate hereto annexed. We also found at this mine, about 20 fathoms above the great vein of coal, another "out cropping" belt of iron-stone, of about 2 feet in thickness, composed of "nodules" intermingled with a light-brown clay or shale. The analysis of this ore will be found in the certificate of Dr. Chilton, under the head of No. 11.

After concluding our investigations here, we proceeded to the "Astor" mine, the opening of which is about one mile and a quarter distant from the former, and the galleries running in nearly an opposite direction.

We followed the galleries and chambers of this mine through several thousand yards in extent, and found the roof uniformly composed of the same material, resting directly on the great vein of coal, and the "falls" every where presenting identical characteristics in color, stratification, thickness, &c., with those of the "Eckhart" mine, from which I have no hesitation in assuming that this iron stone *forms the next geological series above, and is coextensive with the great vein* of coal of the Frostburgh region.

I should have had the pleasure of submitting this report at an earlier day, but for the repeated tests and great care required at the hands of the chemist, the entire reliability that may therefore be placed in the result, I trust will be sufficient compensation for the delay.

It is proper to state that these experiments afford but a limited *test* of the whole bed; still it is believed that the several analyses, together with the thickness of the several strata from which they result, afford sufficient evidence of the great value of this new development.

When compared with the black band iron-stone of Scotland, the description of a large portion of the *overlie* in the Cumberland mines would be strikingly similar—almost identical, in all save in extent. The three richest strata already stated, present an aggregate thickness of not less than five feet; whilst the thickest vein or bed found in Scotland, as far as I have been able to learn, does not exceed sixteen inches. Two of the important veins of this iron-stone found in Scotland, and worked with great profit, are situate in the parish of Old Monkland, and known as the "Airdric Mines," one of which is only six inches thick, and yields from 20 to 21 per cent. of iron; the other is ten inches thick, and yields from 34 to 35 per cent. of iron. The two most important veins are found on the "Dryden Estate," near Edinburgh; one of which is fourteen inches thick, and yields 25.8 per cent. of iron; and the other is sixteen inches thick, and yields 42.8 per cent. of iron.

One of the peculiar features of this species of iron-stone, is the facility with which it is torrefied or roasted, and produces from the stone of apparently a very low percentage of iron, a very rich ore.

Several tests of this kind, made at your Company's Mines, afforded strong evidence that nearly the entire mass of stone overlaying the "great coal vein," may be advantageously used.

From experiments and observations I am convinced that this vein will be found *practically* the richest, as it is vastly the most extensive of the kind known.

Permit me, therefore, in conclusion, to congratulate your Company upon their possessing not only the finest and most accessible vein of coal in this country, but also upon the discovery of this truly Herculean bed of iron, which must add almost incalculable wealth to their already rich possessions.

Your obedient Servant,

A. M. SHERMAN.

CERTIFICATE REFERRED TO IN ANNEXED REPORT.

The result of the analyses of the samples of Clay, Iron Ores, Pyritous Slate, &c., left with me by A. M. Sherman.

No. 1.

Iron,	42.38
Silica,	6.00
Alumina,	4.06
Lime and Magnesia	1.16
Carbon	.81
Sulphur,	10.21
Carbonic Acid, Oxygen, Water and Loss,	45.38
	100.00

No. 2.

Iron,	23.81
Silica,	27.88
Alumina,	10.12
Lime and Magnesia,	.22
Carbon,	.64
Sulphur	18.00
Carbonic Acid, Oxygen, Water and Loss,	19.33
	100.00

No. 3.

Iron,	4.89
Silica	62.40
Alumina,	24.10
Lime and Magnesia,	2.05
Carbon,	.51
Sulphur,	a trace
Oxygen, Carbonic Acid, Water and Loss,	6.05
	100.00

No. 6.

Iron,	33.60
Silica,	10.06
Alumina,	8.21
Lime and Magnesia,	1.01
Carbon,	0.82
Sulphur,	1.21
Carbonic Acid, Oxygen, Water and Loss,	45.09
	100.00

No. 7.

Iron,	9.10
Silica,	50.63
Alumina,	25.16
Lime and Magnesia,	1.81
Carbon,	.44
Sulphur,	a trace
Carbonic Acid, Oxygen, Water and Loss,	12.81
	100.00

No. 8.

Iron,	9.57
Silica,	42.16
Alumina,	24.73
Magnesia,	7.05
Lime,	1.40
Carbon,	0.45
Sulphur,	a trace
Carbonic Acid, Oxygen, Water and Loss,	14.64
	100.00

No. 11.

Iron,	25.20
Silica,	21.59
Alumina,	16.41
Lime,	5.81
Magnesia,	.69
Carbon,	.44
Sulphur,	a trace
Carbonic Acid, Oxygen, Water and Loss,	30.36
	100.00

JAMES R. CHILTON, M.D.
CHEMIST.

New York, February 14th, 1855.

VIEILLE MONTAGNE MINES.

At the Cornwall Geological Society, the Rev. J. Punnett, M. A., Fellow of the Cambridge Philosophical Society, read a paper of the Zinc and Lead Mines, and the processes used in Smelting the Ores, at Stolberg and La Vieille Montagne.

Zinc, the consumption of which has wonderfully increased within the present century, is produced in large quantities from the neighborhood of Aix-la-Chapelle, principally from the Stolberg and Vieille Montagne Mines. The ore, almost entirely carbonate of zinc, is found in veins, varying in size, and traversing the rocks much in the same way as the copper and tin lodes in Cornwall. The reduction of it to a metallic state is always a tedious and expensive process. In connection with one of the smelting-houses at Stolberg, the preparatory operations were principally performed by calcination; in the other by successive washings. They had erected Brunton's frame, but the directors informed Mr. Punnett that it had not been found effective, and it was not then in use. To produce 1 ton of metallic zinc seven tons of coals are required, and as coals cost about 10s. per ton, the expense of fuel alone in the smelting is 3*l.* 10s. per ton. The ore is not thrown loose into the furnace with the flux, as in smelting tin-stuff, but is confined in vessels called *mouffles*, which are made of baked clay, and do not generally differ in shape from our earthenware ones. A hole is perforated in the flat face of the mouffle, and the metal, when fused, is conducted by a pipe into the moulds to cool, after which it is fit for the market. The treatment of the silver-lead ores did not vary essentially from that which is adopted in England. The workmen of La Vieille Montagne are combined into a *société*, under the control of their employers, and are regulated by a code called the *caifée des ouvriers.* The miners pay a monthly subscription for medical advice, when they need it, from accident or sickness; but, beyond this, they have an opportunity of making a provision, in case of permanent disability or old age. Each man contributes to this latter fund 2 per cent. of his gettings; and the company of adventurers contribute, for the same purpose, another 2 per cent., making the sum equal to 1-25th of the whole earnings of the men employed. When a man becomes chargeable to this fund, if he has been in the establishment under 10 years, he receives weekly pay equal to one fourth of his average gettings; if above 10 and under 20 years, one half; if above 20 and under 30 years, three fourths; and if above 30 years, a weekly sum equal to his whole average weekly wages. A school and hospital are also attached to the establishment, the whole of which bears upon it the impress of the most perfect system of order and arrangement. The ore, calamine, or carbonate of zinc, is compact and earthy. The silicate of zinc also occurs, but not in any large quantities. The mine is an open one, and the basin has been excavated to a depth of 25 fathoms. Below the bottom of this basin shafts have been sunk, to a depth of 5 or 6 fathoms, for the extraction of the ore. The walls of the excavation, of a dark ferruginous hue, are of dolomite, which on one side projects into the basin with a bold buttress, alternating with a dark schistose rock, into neither of which does the zinc ore penetrate. The mine has been worked for more than 500 years; though it is only within the last 15 years that the operations have been vigorously prosecuted under the existing system. The ore, when brought to grass, is principally in the form of nodules, varying in size and magnitude from that of a 64 pounder down to the size of a small peg-top. These nodules are piled with great regularity, in long pyramidal masses, by the side of tramroads, along which the ore, as it comes from the mine, is conveyed in hand-wagons. The shape of the masses is very similar to those in which cannon balls are piled up; and, at a distance, might be mistaken for them. The annual quantity of ore raised from this enormous deposit is no less than 56,000 tons, chiefly in nodules, but a portion of it in smaller pieces. It contains on an average 37 or 38 per cent. of metal; so

that, taking the price of zinc, which it now is, at about 21*l.* per ton, the value of the metal produced annually is between 400,000*l.* and 500,000*l.* sterling. The economy of space, time, materials, and labor has been evidently studied throughout. No piles of rubbish are strewed about, giving a desolate and disorderly appearance to the mine. The tramways are swept as clean as a gravel walk. Method prevails every where. Every thing is carried on by rule and measure; even the "deads" are weighed on a drawbridge. The ore, having been prepared by successive washings and calcinings, is smelted, by much the same process as at Stolberg.

Mr. Punnett added, that on visiting the works he had received the benefit of Mr. Bolitho's knowledge of one branch of smelting, as that gentleman accompanied him, and also of the explanations of M. Piot.

Sir C. Lemon remarked that at Mr. Taylor's works, in North Wales, precisely the same process was carried on, in separating the silver from the lead, as that described by Mr. Punnett, and it was worth any one's while at all interested in the subject to call and see the works.

Mr. Tweedy said, at Messrs. Michell's, at Point, a process invented by Mr. Pattinson, of the north of England, was employed for separating the lead and silver.

Mr. Punnett said that Mr. Bolitho had observed nothing that was new at these works, in a scientific point of view, but the order and beautiful arrangement he had never seen surpassed.

Mr. Carne believed the only process used generally was cupulation.

IMPROVEMENT IN THE MANUFACTURE OF STEEL—ELECTRICITY.

The importance of carrying out the steel manufacture of this country to as great a degree of perfection as possible, and thus rendering us independent of continental Europe, or other countries, is a subject which has long occupied the earnest attention of metallurgists and manufacturers. That there are ores of iron within our reach which give every facility for such result has long been proved by laboratory experiment, and we have no doubt will eventually be successfully effected on a large scale. Many unsuccessful attempts have been made to reduce the ores, and effect the carbonization of pure iron by means of electricity; but we are happy in now being able to state that at the present moment much interest is shown in a process by which an electric current is employed in producing a superior quality of steel, direct from the ore. This process is the discovery of Mr. Adrian Chenot, whose perseverance has at length given practical proofs of the advantages of the employment of this subtle agent in commercial manufacture. Mr. Chenot, we understand, has by this process made considerable quantities of steel, of superior quality, 80 per cent. under the present cost, besides performing in 10 days what required 40 on the old system—a vast economy in time and labor. The principal features have nothing in common with processes at present in use, but consist, in the first place, of an electro-sorting machine, to separate the crushed ore, and to bring it to its maximum standard of pureness, according to which is the resulting steel. A system of cementation, or addition of carbon and other matters, by a *cold process*, by which this delicate part of the manipulation can be effected in well-determined and exact proportions; and in a peculiar method of producing a sponge from the ore. The whole metallic process is accomplished with an economy of 50 per cent. in fuel and manual labor, welding, melting, &c. Mr. Chenot asserts that he can manufacture steel for 32*l.* per ton, on his premises at Clichy la Garenne, where fuel and labor are both dear, superior in quality to steel sold in Paris at 100*l.* per ton.

ZINC ROOFS.

A square of 100 ft. of zinc, at 22 oz. to the foot (No. 14 gauge), weighs when laid on with laps and rolls 150 lbs.; the same surface in Bangor queen slates weighs 830 lbs., and in plain tiles 1,900 lbs. Zinc is, consequently, 5½

times lighter that slates, and nearly 14 times lighter than tiles, in addition to the saving of surface and weight, by the flatness and lightness of the framework and supporting walls. As compared with lead, the density of zinc is 7·19, while that of lead is 11·35; the tenacity of zinc is 109·8, and that of lead is 27·7, from whence it follows, that while a sheet of zinc of equal thickness to one of lead is only two-thirds the weight, its strength or sustaining power is four times that of lead, while the cost is proportionately low as applied to each material.—*London paper.*

NEW PROCESS FOR ENGRAVING ON ZINC.

M. Dumont, an engraver (*Rue Dauphine*, 17), describes, under the name of *Zincography*, a process for electric engraving, which is promising. Upon a thick plate of zinc, planed and grained with a steel tool and fine sand, he draws any subject with a kind of lithographic crayon; upon the design, when finished, he sprinkles a fine powder, mixed with rosin, Burgundy pitch, and bitumen of Judea; by heating the zinc plate he melts this powder, which is converted into a varnish, and spreads over the parts of the surface which have been covered with fat crayon, that is, on every thing which constitutes the design. To bite in the plate, and obtain the design in relief, he plunges it, while in connection with the positive pole of the pile, into a bath of sulphate of zinc, in face of another plate connected with the negative pole; the current passes and corrodes the zinc which is not covered by the ink, and thus the design is brought out; from the plate thus engraved in relief, a gutta percha mould is taken, in which copper is deposited to obtain the engraved plate, from which proofs may be taken by the ordinary typographic press. The process invented by M. Dumont is a new application of the principle first applied by M. Beuviere, and which M. Baldus has successfully used in his attempts at photographic engraving.—*Cosmos*, vol. v., p. 292.

QUARRIES AND CLAYS.

BRICK BURNING WITH COAL.

In vol. 3, pages 110 and 228, will be found an article upon the use of Cumberland coal for burning bricks. In the Cumberland Journal Mr. D. Blocher describes his experience with the same fuel as follows:

I differ with the New York burners in the manner of constructing kilns. My experience proves that kilns for coal should not be constructed over 32 bricks wide—with 4 brick benches, and with grates and flues in each arch four feet long. In building up the casements I leave an air chamber one foot deep and one foot wide—the length of the grates. I place my grates over these air pits, on a level with the floor of my kilns, and leave a hole in the casement immediately over the grate, through which the ashes may be stirred down into the air pit and the cinder withdrawn. About two feet above this another hole is left, into which the coal is thrown, and closed either with an iron door, or by heaping the coal so as to exclude the air. This excludes all the cold air except that which passes through the air chamber or ash pit below, and thence through the body of burning coal before it reaches the brick; hence the arches are preserved, and the brick in the arches are not liable to become shattered or broken. Several of our brick makers are now burning kilns without the use of grates. Their kilns are constructed as above, except the air chamber.

Kilns built with air chambers, and grates extending through the whole length of the arch, must necessarily require constant attention, else cold air will find its way to the brick, and not only retard the burning, but cause imperfections in the brick themselves. The labor of keeping the fires in order must be considerably over that of the simple mode I suggest. My hands are never disturbed over three times during the night to fire their kiln, whilst under the New York plan, it seems to me that it would require filling at least once every hour. In addition to this, there is a saving of at least three hundred per cent. in the construction of the kiln bottoms.

In the Scientific American Mr. F. H. Smith, of Baltimore, thus writes upon the same subject:

For several years past I have given much attention to burning bricks with Cumberland coal, and for that purpose built a kiln expressly as an experimental one. It was altered and re-altered again and again, often attended with loss and disappointment. My progress was watched with interest by others of the profession, and some of my abortions have been imitated and put forth to the world as new.

The late rise in the price of wood has stimulated me to still further efforts, and at length my labors have been crowned with complete success.

By a simple arrangement of the flues, the long sought for desideratum of settling both heads at once, is accomplished, and strange as it may seem, by closing all the mouths during the last half of the burning—just when most important—the kiln is fed with hot air. I have just burned a kiln of twelve arches, set 40 high, containing 260,000 bricks, with 87 tons of coal and eight cords of wood, no coal dust in the clay. The same kiln in the old way has generally consumed one hundred and ten cords of wood, often more. A comparison will show this result at present prices, both delivered at the kiln.

110 cords of wood, $4 50		$495
87 tons of coal, $4	$148	
8 cords of wood, $4 50	36	—184
Difference in favor of coal, ...		$311

In the use of coal much depends on the management. We are only beginning to learn something about it. In November last a locomotive on the Baltimore and Ohio Railroad, consumed 5,922 lbs. of coal running from Martinsburgh. The same engineer after several trials ran it with the same train and used only 3,970 lbs.

The feed door should be opened as seldom as possible. The fireman in the case above mentioned, stood ready with his shovel filled, opened the door rapidly, scattered the coal lightly over the surface, then closed the door with his foot. Feed often but light; the fire may be smothered with coal as well as water. Keep the grates free of clinker and ashes. I have a small middle door for the purpose, through which this is done without opening the larger one. The bed of coal should never exceed six inches in depth, and should be kept level. Unfortunately, in the burning of this kiln, I had none but green hands, and in spite of every care I sometimes found twice the proper quantity put on. This not only wastes coal, but obstructs the draught, and keeps the heat below, instead of above, where it is required.

NEW KIND OF BRICK.

We were shown yesterday an entirely new material for the construction of buildings. It is a preparation of sand and lime put into moulds, and operated upon with a most powerful press. The specimens we saw had about three times the superficial area of a common brick, though, of course, their

size would depend upon the pleasure of the maker. They are made with an open space in the centre, occupying one half the length and about one third the breadth of the brick. Those we saw were a handsome gray color, as smooth as dressed stone could be, and apparently as solid as granite. Their real solidity was about equal to a good burnt brick, though they had been made but about three weeks, and time and exposure is expected to harden them continually. They can be furnished as cheaply as brick, and unless some difficulty is developed with regard to them not now apparent, it seems to us they must come into active demand for building purposes. They would certainly appear as beautiful as the finest stone, and making, as they do, a hollow wall, with a smooth interior surface, they can be papered against, or painted, or whitewashed, without the necessity of lathing or plastering.—*Kenosha* (Wis.) *Telegraph.*

PORTER'S STONE-DRESSING MACHINE.

This machine is based on the principle of the mallet and chisel, as ordinarily used by hand in the act of stone dressing. It consists of an adjustable frame, in which is arranged a tool-holder and a series of hammers, disposed at an angle of about forty-five degrees, the angle being increased or diminished according to the hardness of the stone to be worked. The hammers run on wheels, and are each one foot in width, being lifted by means of cams attached to a common shaft, and thrown down in rapid succession by the action of springs against the tool-holder, which is so adjusted as to firmly retain the cutters in the required position, constantly resting upon the surface of the stone, which is placed on a carriage that moves continuously at the rate of from twenty-five to fifty inches per minute, according to the hardness of the stone, carrying the cutters back as the hammers are lifted after each successive blow, each hammer giving about four hundred blows per minute. The number of hammers varies in each machine, according to the width of the cutting surface, which is from two feet to six feet wide. The tools used are very similar in form to those used by hand, and the machine cuts plain surfaces and all kinds of mouldings and columns with great rapidity and precision. The tool-holder is furnished with leather or India rubber cushions, resting upon the heads of the cutters, the motions of which are regulated by means of a rest-bar, in such manner as to enable the operator to give any desired intensity to each blow necessary to secure the most delicate execution. This machine is exceedingly simple, compact and durable, requiring but little power te keep it in full action, is easily kept in order, and requires but three men to attend it while performing the labor of from 75 to 100 workmen. It is estimated by the inventor, that the general introduction of this machine into our stone-yards would reduce the cost of dressed stone of all kinds about 80 per cent. below present rates.

VULCANIZED STONE.

A fresh invention has been patented for hardening the soft stones of the country. Specimens have been exhibited of great hardness, susceptible of high polish, which preserve a sharp arris, and are stated to be proof against the alternations of our climate, and to withstand not only the London atmosphere, but even the action of the strongest acids. The proprietors allege that, by a solution, chemically prepared, and laid on with a brush in dry weather, the decay of old buildings may be arrested; and the material acted on, whether stone, compo, or brick, be made perfectly non-absorbent.

The specification says,—"It is proposed (in all cases where it is practicable) in applying any indurating mixtures, to inclose the stone or other materials to be operated upon in an air-tight chamber, and exhaust, or partially exhaust, the same, and then allow the indurating substance, whether hot or cold, to trickle down or flow into the chamber, to fill the vacuum, the

effect of which will be, that the liquid indurating substance will readily find its way into the pores of the stone or other material, and become incorporated therewith.

Mixture No. 1.—The composition of this solution is as follows:—56 parts, by weight, of sulphur, dissolved by the aid of steam heat, or dry heat, in 44 parts dilute vinegar, or acetic acid, containing 17 parts of acid to 8 of water.

In preparing indurating mixtures to be applied to the exteriors and interiors of buildings, whether possessing a surface of brick, stone, cement, or plaster, I employ the following ingredients:—Shellac, 14 parts, by weight; seed lac, 14 parts; coarse turpentine, one part; pyroligneous spirit, 40 parts;" —and other mixtures.—*London Builder.*

ARTIFICIAL STONE.

G. Juste, of Paris, patentee. This invention consists in manufacturing stones from all kinds of sand, and metallic ore. The inventor first submits these materials to the action of strong heat in an oven, and when they are at the point of red heat, they are taken out and reduced to powder in a large mortar, by stamping. The substances thus reduced are then mixed with some fluxes for easy fusion, such as boracic acid, oxide of lead, and lead and soda. They are then melted in an oven, from whence they are taken out and thrown into a vessel containing cold water. After this these matters are again triturated and reduced to an impalpable powder, and after being pressed into moulds of fire-clay, are placed in a potter's oven, where they are submitted to a great heat. After this they are withdrawn, and found to be moulded into blocks according to the form of the moulds. The moulds may be of any pattern, ornamented or merely useful.

MISCELLANIES.

LIME IN SCOTLAND.

An important geological discovery has recently been made in Scotland. A large mountain, called Zore-More, near Applecross, on the west coast, on being accidentally excavated, presented a substratum of pure lime, within five feet of the surface; and on prosecuting the discovery by a further excavation, it was ascertained that the whole mountain, except an average surface of 20 ft. consists of lime fit for building or agricultural purposes. The hill appears to have been at one time a stupendous limestone rock, which has been submitted to the action of intense heat. On the summit of the mountain volcanic remains, vitrified stone and lava, have been found.—*London Journal.*

SUBSTITUTE FOR CANDLES IN MINES.

At the Royal Saxon Works, near Freiberg, and most of the private establishments of that country, lamps are used; these are of brass, about 3 inches in diameter, and are placed in a wooden case, lined with tin, which serves as a reflector; they will burn for about ten hours, and the cost for a core may be probably one penny; certainly, unless great waste is exercised, it cannot exceed that sum. The prime cost of one of these lamps in Hamburg is about 8d.; but I should calculate it can be manufactured here at about one-half that expense. The miners descend deep shafts in Saxony without spilling any of their oil; and if the lamp be kept clean, which can be done with comparatively little trouble, more light is obtained from them than an ordinary candle; while the flickering and guttering, which is always observable in ascending or descending the shaft, is completely avoided. If one or two mining proprietors would give the Freiberg lamps a trial, they would find the expenditure of their property, as far as regarded light, most materially reduced.

THE

MINING MAGAZINE:

DEVOTED TO

Mines, Mining Operations, Metallurgy, &c. &c.

VOL. IV.—MARCH, 1855.—No. III.

Art. I.—MINES OF NEW JERSEY.*

MAGNETIC IRON ORE—MAGNETITE—MAGNETIC OXIDE OF IRON —NATIVE MAGNET—LOADSTONE.

This ore, when pure, has an iron black color, and metallic lustre; is strongly magnetic; produces a black streak when rubbed on a surface of unglazed white porcelain, and gives a black powder when pulverized. Its composition is oxygen and iron—a combination of the protoxide and peroxide—72.4 of iron and 27.6 of oxygen. It may be readily distinguished from other ores of iron by its black streak and powder, and magnetic properties.

The description here given is that of pure magnetic iron ore, but this substance is very often associated with foreign matter, as quartz, mica, hornblende, feldspar, etc., which alter the color and general character of the ore, according to the kind, quantity, and texture of the foreign matter. It is one of the most valuable ores of iron; and from it the greater part of the iron of this State is manufactured. It occurs in veins and beds, and is disseminated through igneous and metamorphic rocks. In this district it occurs chiefly in the igneous and metamorphic rocks of the Highland sand valley of the Wallkill.

The following are among the most important localities:

WAWAYANDA MINE.

This mine is situated on the Wawayanda Mountain, half a mile from the New York State line, and two and a half miles northeast of the Wawayanda Lake. The prevailing character of the rock, in which the ore occurs, is gneiss. It is exceedingly variable in composition and texture. Mica enters but slightly into any of the rocks throughout the whole mountain, and in many places it is entirely absent. When entirely absent, hornblende, or magnetic iron ore, in grains, takes its place, forming a

* From a description of the formations of Sussex County, in the Report of the Geological Survey of New Jersey. By Prof. Wm. Kitchell.

syenitic gneiss. The rock in some places is composed only of feldspar and quartz, the former being its principal ingredient.

Four deposits of ore have been opened and worked. Their prevailing course is northeast and southwest, and their dip from twenty to forty degrees to the southeast.

Commencing at the southeasterly deposit, and taking them in their numerical order, we find that the first is not worked at the present time, and has not been for several years, because the ore is more accessible and more abundant in the other deposits. On account of the water in the shaft, and the dilapidated condition of its timbering, I was unable to make a personal examination, but I was, however, informed by the mining captain, that it has been worked to the depth of one hundred and ten feet, and one hundred on the deposit; and that the ore is from twelve to fourteen feet in width, at the bottom of the shaft.

The second deposit occurs fifty feet northwest of the first. It has been worked to the depth of eighty feet, and one hundred feet on the deposit; and at its present depth is thirty feet in width.

The third deposit is seventy-five feet from the second. Here the ore occurs in the form of a bed, or irregular deposit, varying from two to twelve feet in width. At its present depth, one extremity of the workings shows the ore six feet in width, and the other two feet.

The fourth deposit, forty-five feet from the third, is from four to five feet in width, and has been worked to the depth of sixty-five feet.

About a quarter of a mile southwest of the Wawayanda Mine, on the property of Mr. Green, openings have been made into the third and fourth deposits, from which a large quantity of ore has been taken. All these deposits are exceedingly irregular, having no well defined walls. They occur between two strata of gneiss of different characters. The underlying stratum is generally a very hard and crystalline syenitic gneiss; the overhanging is chiefly composed of feldspar and quartz; the former in large imperfect crystals and greatly predominating. They are frequently displaced and altered by dikes of granite, which in some cases are injected into the deposit, and in others, cut it off entirely and throw it aside. Numerous sketches and sections illustrating the dislocations have been taken, and will accompany the detailed description of this mine in the final report, together with the composition of the ores, metallurgy, etc.

The ore from this mine is of an excellent quality, a large proportion of it being entirely free from foreign substances. It is highly magnetic, and possesses polarity. Iron pyrites sometimes occurs in very small quantities at the junction of the dikes and ore, which renders them easy of separation. It is chiefly smelted in a charcoal furnace upon the borders of

Wawayanda Lake, and produces an iron peculiarly adapted to the manufacture of car wheels. Almost all of it is consumed by Whitney & Son, of Philadelphia, for this purpose. The mine and furnace are owned by Oliver Ames & Sons, of Boston, who commenced operations here about nine years ago. Until January last the work had been suspended for about four years, and since this time has been carried on with great activity.

Following the course of the Wawayanda Mountain towards the southwest, indications of the existence of magnetic iron ore are every where visible. In some places it is disseminated in grains through the rock, forming one of its constituent minerals; in others it occurs in "strings," or small veins, from one to several inches in width. In some places, large deposits are indicated by the magnetic needle.

OGDEN MINE.

The next important deposit of magnetic ore which has been opened and worked, is upon the Wallkill Mountain, three miles southeast of Franklin Furnace. It was opened in the year 1772 by Abram Ogden, and has since then been worked, at intervals, by different parties, its name always changing with the name of its proprietor. It has been known, at various times, by the name of Kinney's, Sharp's, and Bird's Mine. At present it is owned by the New Jersey Franklinite Company, and worked by Edward De Camp, of Charlottenburgh, whose name it bears. The ore occurs in the form of an irregular vein or deposit varying from ten to thirty feet in width. Its general course is northeast and southwest, and its dip is at an angle of ten degrees to the southeast. It is now worked forty feet from the surface, and is fifteen feet in width. The ore which it yields is of a variable quality, some being entirely free from foreign substances, while with a large proportion of it may be found the constituent minerals of the gneiss, and, in some cases, iron pyrites in small quantities. This ore is smelted in Hopewell Forge.

VULCAN MINE.

This mine is situated on Vulcan Head, on the property of Richard R. Morris, Esq., about half a mile southwest of the Ogden Mine. Two deposits of ore have been opened by means of shafts sunk to the depth of thirty feet. The first shaft exposes a mass of ore ten feet in width, dipping towards the southeast at an angle of fourteen degrees. The ore is highly magnetic, and contains a considerable quantity of feldspar and iron pyrites associated with it. The second shaft exposes a mass of ore nine feet in width, associated to a considerable extent with grains of quartz and feldspar; but free

from iron pyrites. Small specks of carbonate and sulphuret of copper are disseminated through some parts of it, but not in a sufficient quantity to injure it as a furnace ore, for which it will answer an excellent purpose.

Following the summit of the Wallkill Mountain towards the southwest, I observed many indications of large deposits of ore. Undoubtedly very extensive beds may be opened in this vicinity, which at no distant day will prove a source of great profit to their proprietors.

SHERMAN'S MINE.

This mine is situated on Slack Brook, three quarters of a mile southeast of Sparta. Several deposits of ore are exposed on either side of the brook, varying from three to ten feet in width. They are very irregular, having no well defined walls, and, in many places, it is difficult to ascertain their limits, because the ore is disseminated to a considerable extent through the adjoining rocks.

SPECULAR IRON—PEROXIDE OF IRON—RED IRON ORE—RED HEMATITE.

This ore of iron, when pure, has a metallic appearance; is of various shades of color, and is composed of seventy metallic iron and thirty oxygen, in one hundred parts. It is easily distinguished from other ores of iron by its reddish streak and powder. In nature it rarely occurs in a pure state, but generally mingled with lime, silica, alumina, &c., when its value depends on the nature and proportion of the foreign material. It is generally found in beds or irregular deposits associated with igneous and metamorphic rocks, more frequently in the latter, or at the junction of the two. A great part of the iron manufactured in different countries is from this ore, and although it requires much more heat to smelt than other ores, yet it produces an iron of excellent quality.

In this district this ore occurs in the white crystalline limestone, and is generally found at or near the junction of that rock with gneiss, syenite and granite. Large bowlders of it are found all along the southeastern border of the white limestone formation from the New York State line across the State to Pennsylvania. A careful examination of the district will undoubtedly be the means of developing extensive deposits of this valuable ore. Among the localities that have already been worked to a considerable extent, I will refer to but two, viz., the Simpson and Andover mines.

SIMPSON MINE.

This mine is in Vernon Township, half a mile from Smithville, and two and a half miles northeast of Hamburgh. The ore occurs in the form of a bed or irregular deposit, from six to ten feet in width, in the white limestone. Excavations have been made into it to the depth of twenty feet, from which considerable quantities have been removed and smelted in the old Hamburgh Furnace, yielding an iron of superior quality. This ore has a brownish red color, a fine steel-grained texture, and a metallic lustre. A large proportion of it is quite pure and almost entirely free from foreign materials.

ANDOVER MINE.

This mine, celebrated as one of the oldest and richest iron mines in this country, is in the township of Newton, near the village of Andover, and in the same geological range and formation as the mine last mentioned. It has been worked at different times from the year seventeen hundred and sixty to the present, and is noted for furnishing an ore peculiarly adapted to the manufacture of steel.* The ore occurs in the form of a large irregular deposit, from sixty to eighty feet in width, and forms the southwestern side of a hill rising upwards of one hundred and fifty feet above water level, and from which during the last seven years over one hundred and twenty thousand tons of ore have been removed. The principal part of the ore is specular iron of different shades of red, gray and blue, and of various qualities. Its color, texture and lustre depend chiefly on the foreign materials with which it is mingled, among which are carbonate of lime, alumina, silica, magnesia, manganese, and magnetic oxide of iron. The following are the statements and analyses which Mr. James C. Kent, the chemist of the Trenton Iron Company, has, at my request, been kind enough to furnish me:

"OFFICE COOPER IRON WORKS,
December 15, 1854.

"The Andover mines, situated at Andover, Sussex County, New Jersey, were originally worked by an English Company prior to the Revolutionary War, from which period up to the year eighteen hundred and forty-seven, they remained unworked. In the latter year they were purchased by Peter Cooper, Esq., for the Trenton Iron Company, who have since continued mining, and, in seven years, have taken from them upwards of one hundred and twenty thousand tons of ore.

* Hon. Jacob W. Miller's address before the New Jersey Society, 1854.

"The ores are principally the peroxide of iron, and the chief varieties are the 'blue' and 'red.'

"The following analyses, selected from a number I have made at different periods, give the composition of the varieties above mentioned.

	Blue.	Blue.	Red.	Red.
Peroxide of Iron,	90	70	65	70
Oxide Manganese,	3	2	4	10
Carb. Lime,		16	16	12
Silica,	6	8	10	6
Alumina,			2	
Magnesia,			1	
	99	99	99	99

"There are other kinds of ore occurring in smaller quantities. I subjoin analyses of the most interesting:

	Brown Ore.	Resinous Ore.
Peroxide Iron,	30	40
Carb. Lime,	35	12
Silica,	30	30
Alumina,	3	3
Oxide Manganese,		15
	98	100

	Carbo Silicate of Manganese.
Protoxide Manganese,	34
Lime,	11
Silica,	33
Alumina,	1
Protoxide Iron,	1.5
Carbonic Acid,	18
	98.5

"These ores, though not unusually rich, are remarkable for the facility and rapidity of their reduction in the smelting furnace.

"The large quantity of the best fluxing materials, such as manganese and carbonate of lime, contained in the ore themselves, renders necessary the small addition of but ten per cent. of fluxing matter in working the ores in the furnaces.

"In one of our furnaces (forty-two feet high and eighteen feet across the boshes), we have made two hundred and thirty tons of pig iron per week for six weeks in succession, with one and a half tons of coal per ton of iron; and the yield for a single week in one furnace has been as high as two hundred and fifty-one tons, an amount unprecedented in the annals of European furnaces. A considerable proportion of the iron produced is of the kind termed 'lamellated.' This iron is a type of the perfect combination of carbon and iron, with the carbon in larger proportion than in any other kind of iron. This species presents in the fracture a silvery brightness, and is beautifully crystallized, some of the crystals having brilliant faces, measuring two inches across. Another variety is the 'radiated,' which presents a fibrous fracture, the fibres radiating from the centre to the outside of the pig.

"The pig iron made at the furnace is puddled at the Rolling Mill of the Company, and the anthracite blooms thus made are converted into the various kinds of bar iron, rails, &c. At the wire mills the blooms are worked and drawn down to the finest wire, unsurpassed in quality; steel of the best description is also produced from the iron; and when wrought iron of great strength and toughness is required, as in the shafts for our largest class steamers, the Andover iron has been thoroughly tested and pronounced unrivalled.

"The Trenton Iron Company have three furnaces at present in operation, requiring to supply them sixty thousand tons of ore per annum. A large proportion of this ore is taken from the Andover mines, yet notwithstanding this heavy demand upon them, the mines promise to yield for many years to come an abundant supply.

"JAMES C. KENT."

LIMONITE—HYDROUS PEROXIDE OF IRON—BOG IRON ORE—YELLOW CLAY IRON STONE.

This ore, when pure, is composed of the hydrous peroxide of iron, and contains about sixty parts of metallic iron in one hundred. It almost always occurs mixed with foreign substances, as lime, alumina, silica, &c., which give to it a variety of forms, and from which its name is derived. Its prevailing colors are various shades of brown and yellow; and its streak and powder are yellow brown. The variety called bog ore sometimes contains phosphorus, and yields a cold short iron, unfit for those purposes which require a tough tenacious metal, but admirably adapted for casting. This ore, in its various forms, occurs in beds associated with rocks of all ages. In this district the greatest deposits are found among the metamorphic rocks of the Wallkill Valley. Bog ore occurs, not unfrequently, in the Blue Mountains, and in the valley of the Delaware, but not in sufficient quantities to be of much practical importance.

On the farm of Chandler Wood, half a mile southwest of the New Turnpike, on the Blue Mountain, is a bed of this ore apparently of considerable extent. It is situated in a marsh at the foot of a sandstone ridge. Its origin may be undoubtedly traced to the iron pyrites which abounds in the sandstones and grits of this mountain, and which, being decomposed, is carried down by the water, and deposited in the low, swampy lands situated at the base of the ridges.

POCHUCK MINE.

Two miles and a half northeast of Hamburgh, between the base of the Pochuck Mountain and a ridge of white limestone,

occurs an extensive bed of brown hematite in stalactitic, mamillary and botryoidal forms, of a fibrous and massive structure. Excavations have been made on the surface, two hundred yards in breadth, and from sixty to eighty feet in depth, from which large quantities of ore have been taken, and smelted in the Hamburgh Furnace. The greater part of the ore occurs in concretionary masses embedded in clay and sand, also in beds of clay of various colors, which have been formed by the decomposition of a quartzose feldspathic rock. Large masses of a quartzose rock, of a honeycomb or cellular structure, containing fibrous limonite of a very pure quality, are associated with the above, having been apparently subjected to an intense heat. This mine has not been worked for a number of years, on account of great depression in the iron business.

EDSALL MINE.

Two miles northeast of Upper Hamburgh, another extensive bed of limonite has been worked. It is situated in a slight depression between the base of the Wallkill Mountain and a small knob of highly ferruginous feldspathic gneiss. Excavations have been made two hundred feet in length and breadth on the surface, and forty feet in depth. The ore is of the same general character, and associated with the same soft feldspathic rock as in the Pochuck Mine.

In following the course of the Wallkill Valley, along the base of the mountain towards the southwest, limonite may be seen in numerous places, mingled with the soil, indicating the existence of other beds, of equal extent and value, through this district. Examinations for this ore should be made at the base of the mountain, in depressions and valleys, and in the vicinity of the white or metamorphic limestone.

FRANKLINITE AND RED OXIDE OF ZINC.

Franklin and Sterling Hill in this district, have long been celebrated for the intricacy of their geological formations, their numerous rare minerals, and extensive and valuable metalliferous deposits. They have attracted men of science from all parts of the world, with a view to collecting specimens with which to enrich their cabinets, and to turning the inexhaustible quantities of franklinite and red oxide of zinc to some practical purpose. Although, from time to time, many attempts have been made to render them available for the manufacture of zinc, iron, or some of their compounds, it was not until within a few years that any favorable results have been obtained. These are among the most valuable contributions which have been made for many years to metallurgical science, and will be long regarded as illustrations of American enterprise and perseverance.

The nature of this report will simply allow the observation that the franklinite and zinc ores are among the extensive and valuable resources of this part of the State. Sketches, maps, sections, etc., illustrating their geology, mineralogy and metallurgy, have been carefully prepared, and will accompany full and detailed descriptions of them in a future report.

FRANKLINITE.

This ore occurs massive, of a compact, coarse and finely granular structure, also crystallized in octahedrons. It has an iron black color, metallic lustre and a dark reddish brown streak and powder, and acts slightly on the magnet. It is composed of iron, manganese and zinc, containing, according to Berthier, of oxide of zinc, 17; of iron, 66; and of manganese, 16 parts; and, according to Dickerson, of oxide of zinc, 21.77; of iron, 66.12; of manganese, 11.99; and of silica, 0.13.

RED OXIDE OF ZINC.

This ore occurs in masses of a granular and foliated structure, also in grains mechanically associated with franklinite, and disseminated in white crystalline limestone. It has a dark red color, and orange yellow streak. When pure, it contains, according to Whitney, 19.74 oxygen, and 80.26 zinc in 100 parts, but it also contains a small per centage of oxide of manganese, to which its red color is ascribed.

These two ores have been found in no country but this, and in no region of it except at Franklin and Stirling Hill. Here they occur in extensive deposits, associated together, and connected with the white crystalline limestone. At Stirling Hill there are two of these deposits from three to fifteen feet in width. Their general course is northeast and southwest, and their dip forty degrees to the southeast. The red oxide of zinc, mechanically associated with franklinite, and, in places, disseminated to a greater or less extent through the limestone, occupies the upper portion of the deposit, while the lower portion is composed of grains and crystals of franklinite mechanically associated with willemite (silicate of zinc), disseminated through the limestone. The greater, or southeasterly deposit, occurs in a limestone bluff, which rises abruptly from one hundred and fifty to two hundred feet, forming a steep southeastern slope. It has been worked four hundred yards on its outcrop, in one place, on the property of the New Jersey Zinc Company, to the depth of two hundred feet. Near the surface, the zinc portion of the deposit was from two to three feet in width; at its present depth it is from six to eight feet in width, and affords an excellent quality of ore. The franklinite portion of the vein is very irregular. In one place it is from fifteen to twenty feet

in width, and of a remarkably pure quality; but, in either direction from this spot, it becomes thinner, and, in many places consists of a few crystals of franklinite very sparingly disseminated through the limestone. The second, or northwesterly deposit, has been recently opened on the property of the Passaic Company. It has been worked to the depth of about forty feet, and as yet does not exhibit the regularity found in the former. A tunnel is now being driven into the base of the hill, which will strike the deposit about ninety feet from its outcrop.

At the present time, two companies are engaged in mining the zinc ores of this locality, and in manufacturing directly therefrom the white oxide of zinc. The one is called the New Jersey Zinc Company, and the other the Passaic Zinc Company. The former was organized in 1848; and their works, situated in Newark, are in successful operation, producing annually between three and four thousand tons of the white oxide of zinc, which is sold as a paint, and is preferred for many purposes to white lead. A small furnace has been recently erected at their works, in which the refuse matter, chiefly franklinite, is smelted for iron.

The works of the Passaic Company have been recently established at Jersey City, where preparations have been made for manufacturing the white oxide on an extensive scale.

The only remaining locality at which these ores have been found, is at Mine Hill, in Franklin, where the franklinite greatly predominates over the other mineral. Two extensive deposits have been exposed, and worked to a considerable extent, crossing Mine Hill for a distance of three quarters of a mile in a northeasterly and southwesterly direction. They occupy the summit of the hill, which rises one hundred and fifty feet above water level; and to this depth the ore may be removed at a trifling expense. The following section on the southwestern slope of the hill, commencing at the northwest, and crossing the formations towards the southeast, represents the relative position of the two deposits of ore.

1. Syenite.
2. Magnetic iron, from two to six feet in width.
3. White limestone, from four to ten feet in width.
4. Franklinite, twenty feet in width.
5. White limestone, sixty feet in width.
6. Franklinite, twenty feet in width.
7. White limestone.

The latter deposit of franklinite (6) has been recently exposed for several hundred yards on its outcrop, exhibiting a mass of nearly pure ore, varying from twenty to fifty feet in width. At an opening in the deposit at the northeastern part of the hill, a considerable quantity of red oxide of zinc is mixed with the franklinite; as far, however, as the deposit is exposed,

but very little zinc occurs. The magnetic iron ore (2) herewith associated, has been formerly worked to a great extent, yielding large quantities of excellent ore which was smelted in the old Franklin Furnace.

The New Jersey Franklinite Company, organized in 1852, is actively engaged in erecting furnaces and suitable buildings within a few yards of the deposits, for the purpose of smelting the ore, which will at the same time yield a superior article of iron as well as the oxide of zinc. One furnace is nearly completed, and will be put into operation in the course of a few weeks. The iron manufactured from the franklinite ore is of an excellent quality, and peculiarly adapted to the production of the best kind of steel. There are many circumstances which render Franklin an admirable location for the successful prosecution of an enterprise of this character. It not only furnishes an inexhaustible quantity of ore, but with the exception of fuel, every other article required in the manufacture of iron and zinc. Building materials of every description, including granite, marble and sandstones; clay for the production of bricks; limestone for plaster, masonry, &c., are in abundance. In addition to all these advantages, nature has here also furnished a never-failing water-power, by which operations of every kind may be greatly facilitated.

SHELL MARL—CALCAREOUS SINTER—CALCAREOUS TUFA—TRAVERTIN.

These terms are applied to deposits of lime from solution in water. They occur generally in springs, ponds, shallow lakes and low marshy lands. Water holding carbonic acid gas in solution, has the property of dissolving carbonate of lime, which is deposited in the form of a fine powder, whenever the carbonic acid gas escapes. This gas is held in solution by rain water, and many spring waters, which, in percolating through limestone rocks, or in passing over their surface, dissolve a portion of the lime, and carry it into ponds, lakes and marshes, where it is deposited in the form of a white calcareous powder. It is there absorbed and secreted by testaceous animals, whose outer covering, or shell, is thus formed. In those situations where a large quantity of calcareous matter is held in solution, these small testaceous animals grow in great abundance, and live but a short time, their places being taken by other generations, which in turn die; and thus large deposits are formed, called *shell marl*. In those situations where but little calcareous matter is held in solution, new generations of testacea, in forming their own shells, consume those of pre-existing ones, and thus the rapid accumulation of shells is retarded. And, again, where a superfluous

amount of carbonate of lime is held in solution, which is very often the case in limestone districts, the lime is deposited with the testaceous remains, which still more rapidly increases the deposits. Shallow ponds, or lakes, where the deposition of shells and lime is rapidly carried on, finally become filled up to the water line; so soon as the water passes off, peat begins to form, and by its annual growth and decay, a deposit of this material is quickly accumulated upon the marl. When in such cases, the peat begins to form on the surface, the testaceous animals do not cease to exist, but on the contrary, continue generation after generation to increase the deposit of marl under the peat, while at the same time the peat is continually increasing upon the surface. It is in this form that extensive deposits of marl occur in almost every part of this county. Wherever such deposits have been examined, they are usually found to rest upon a bed of clay, sand or gravel, and are succeeded by muck or peat. At or near the junction of the peat and marl, a layer of living testacea generally occurs, mingled with the peat. From twenty-five to thirty inches below this the living animals disappear, their places being occupied by their remains in a decomposed state. The shells most frequently found in these deposits are the Limnea jugularis, Valvata tricarinata, Cyclas similis, Planorbis bicarinata, and some other species.

Springs holding a large quantity of lime in solution, sometimes deposit it on the surface in the form of a loose porous mass. It often happens that twigs and leaves are enveloped in these deposits, and their impressions thus preserved in a most beautiful and perfect manner. Such deposits are called calcareous sinter, calcareous tufa or travertin. Extensive deposits of calcareous sinter and shell marl are found in every part of this county. The most important localities are in the limestone districts. A large deposit of shell marl is found along the course of Chambers' Mill Brook, in Montague Township, on the farm of Isaac Bonnell, Esq. This deposit covers an area of from seventy-five to one hundred acres. It is situated in a low meadow or marshy land, surrounded by limestone hills; and this meadow has, at one time doubtless, been covered by a shallow lake or pond. Near the centre of the deposit, an examination was made to the depth of eighteen feet, giving the following section:

Peat and muck, 3 feet.

Marl and peat containing living testacea, 4 feet.

Marl, very fine, made up of decomposed shells, 11 feet.

The instrument not being of sufficient length, the whole thickness of the deposit was not ascertained. In other places where examinations were made, the peat was found to be from five to ten feet in thickness; and from six to ten feet from the surface, were found embedded the branches and trunks of trees from one to two feet in diameter.

On the Little Flatkill, two miles southeast of the town of Montague, upon the property of I. Cole, Esq., is found another deposit, covering an area of fifty acres. The peat resting upon the marl, is from four to six feet in thickness; and the marl from six to eight feet, resting upon a bed of sand and gravel. On the farm of Mr. Isaiah Vannetten, one mile and a half northeast of Hainsville, is another deposit covering an area of twenty acres, and overlaid by a deposit of peat from three to eight feet in thickness. On the farm of Mr. Benjamin P. Van Syckle, in Sandiston Township, three miles northwest of Tuttle's Corner, and two miles southeast of Dingman's Ferry, is found a deposit of calcareous sinter, covering an area of at least five acres. It is exposed on either side of a small stream to the depth of several feet. A well fifteen feet deep has been dug into it without passing through its whole extent. Though very hard and compact upon the surface, it becomes softer and more pulverulent as it descends. In it are found numerous nodules, or concretionary masses, which have been formed by the deposition of the lime around a twig or some other substance as a nucleus for the aggregation of calcareous particles. The source of this deposit may be traced to a spring, half a mile distant, near the house of Mr. James Struble. This spring issues from the base of limestone ridge, and empties into a small reservoir or pond, whence it passes to Mr. Van Syckle's land. In the bottom of this reservoir grows the Chara, a genus of aquatic plants. While growing at the bottom of ponds and streams, it has a dark green color, but upon being removed and exposed directly to the atmosphere, it soon becomes white and crumbles to a fine powder composed chiefly of the carbonate of lime. Large quantities of it are constantly forming at the bottom of this pond, and it requires to be removed, from time to time, in order to prevent the pond from being filled by its rapid accumulation.

Another extensive deposit of calcareous sinter is found on the limestone slope at Dingman's Ferry, a little above the Delaware River. It covers an extensive area, and is from fifteen to twenty-five feet in thickness, as may be seen by examining either side of a small stream passing through it, and from which the calcareous matter has been deposited. On the surface, where it is exposed directly to the atmosphere, it is very hard, and emits a ringing sound when struck with the hammer. A few feet from the surface it is soft and pulverulent, and of a light gray color. It contains numerous beautiful and perfect impressions of leaves, branches, etc.

Inexhaustible quantities of marl and calcareous sinter may be obtained from the above localities at a comparatively trifling expense.

In the Kittatinny and Wallkill Valleys, deposits of marl

are numerous. They are found several feet in thickness, at the bottom of the lakes and ponds, marshes, and meadow lands so abundant in these districts. A very common name for these small collections of water is "White Pond," of which several are so called in the county. This name is given to them on account of the deposits of shells distinctly visible at their bottom.

Peat and marl are found in abundance in Vernon Township, on Black Creek, the meadows opposite the town of Vernon covering an area of several hundreds of acres. The peat here varies from four to fifteen feet in thickness, and the marl from one to ten. Numerous other localities have been noticed and will be referred to in a future report.

Deposits of marl occur most generally in peaty meadows and marshes; and in such places may be easily examined by thrusting through the surface a pole or rod, to which the marl, if present, will adhere. It may also be done by means of a spade or shovel; but the examination is sometimes tedious, on account of the presence of water, which often removes the marl from the pole, or renders the use of the spade laborious. An instrument admirably adapted to such examinations has been employed during the past year. It is so constructed that a quantity of peat, marl, soil, etc., may be taken from any depth without mixing it with the other materials surrounding it.

The accompanying figures will give an idea of its construction: A B is the whole instrument, sixteen feet in length. A is its point or borer; B its handle. The point or borer, A, is twelve inches in length, and one inch and a half at its greatest diameter. It is formed of two half cylinders, an exterior, *a*, and an interior, *b*. They are so arranged that when put together, as at *c*, the exterior rolls upon the interior, causing the whole to present the form of a conical or tapering cylinder. The handle is made of strong wood, and in detached portions, four feet in length, which may be connected at pleasure, by means of an iron band, as at *d*. The object in having the handle in detached portions is for convenience of transportation, and for increasing its length as circumstances may demand. The instrument being closed, as represented at A B, it is forced into the peat or marl to the depth at which the examination is to be made; then by turning the handle to the right, the pressure on the exterior cylinder, forces it behind the interior, and in this manner the instrument is opened. It is then forced downward six or eight inches, or the length of the cylinder, when the hollow becomes filled. The handle being then turned towards the left, the cylinder encloses a portion of peat or other matter taken from the spot where the instrument stopped. Its precise depth is indicated by the number of feet and inches represented on the handle.*

* For a description of this instrument, from which it was made, I am indebted to Leo Sesquereaux, of Columbus, Ohio, a gentleman who has made extensive examinations of the peat and coal lands of Europe and this country.

Art. II.—GENERAL REMARKS AND RULES ON THE WORKING AND WINNING OF COAL.*

(Translated for the Mining Magazine.)

CLASSIFICATION OF THE DIFFERENT COAL-MINING SYSTEMS.

From the investigation of the different methods employed in the most important coal districts, for the working of strata of a small or medium magnitude, it is manifest that they may be divided into five different systems.

1. *The working with pillars and galleries*, by which is distinguished the preparation of the field from the proper winning or working. The former consists in dividing the coal-field into rectangular pillars, which are then won by the latter. This method, which is exclusively in vogue in the departments of

* Traité de l'Exploitation de Mines de Houille, ou Exposition comparative des Méthodes employées en Belgique, en France, en Allemagne, et en Angleterre, pour l'Arrachement et l'Extraction des Minéraux combustibles; par A. T. Ponson, Ingénieur civil des Mines. Luttich, by Nobiet, 1852-53, 4 volumes, of 600-700 pages each, and Atlas of about 80 tables.

Considering the great importance of mineral coal, one must really wonder that hitherto it has not been the object of a special work devoted to its production, and consequently we may rejoice that the task has been accomplished by such skilful hands. The work before us belongs undoubtedly to the most important publications in regard to our coal mining knowledge. The plan of the work is as follows: the first chapter comprises practical remarks on the geology of coal regions, and on the formations of the hanging strata; it further contains a description of some important coal basins, and treats of the search for mineral coal by means of boring, &c. In the second chapter, the means of exploring coal strata by levels and shafts, their working, supporting, and also the restraining of the water in the hanging layers, &c., are discussed. The third chapter is devoted to natural and artificial ventilation, illumination, and burning of coal mines. The fourth chapter comprises the winning work and its processes, which are explained by examples from a great many different coal districts. In the fifth chapter, the hauling and hoisting in horizontal and inclined galleries, in shafts, and on the surface, is treated. As in coal mining, very large masses have to be forwarded in a short time, hauling and hoisting is of a peculiar importance. The means of ascending and descending mines are also spoken of. The sixth chapter is devoted to the drainage, by means of restraining the surface water by dams and likewise by pumps. The pumps, connecting rods, and motive machines are described. The seventh chapter treats of the mining economy; of the materials, tools, work, and wages of laborers, &c.; of the estimated costs of mines, &c. In the eighth chapter, finally, are explained the operations of surveying in relation to coal mines.

The author of this work has strictly confined himself to experience; and unfounded theories are entirely disregarded. All illustrations, being masterly executed, are, with few exceptions, taken from reality, accompanied by a scale of such a kind that they may be used. Not only has the author, by practical employment in coal mines for eighteen years, and by visiting the most important districts, attained a great knowledge of this branch of mining, but he has also used the best domestic and foreign publications on mining, and also the manuscript manuals and notices of other mining engineers. We repeat that Ponson's work, beyond all doubt, must be looked upon as a highly important addition to mining literature, the more so as we were hitherto entirely destitute of any useful treatise on coal mining.

Middle and Southern France, and which is also employed in the different coal basins of England, bears the greatest similarity to the following:

2. *The working with galleries and long pillars*, which is customary in the Wurmrevier, near Aix-la-Chapelle, in the basins of Saarbruecken and the Ruhr, in Silesia, and in Wales. It differs from the foregoing, with which it has often been construed. The long pillars, with this work, are only perforated at intervals, and for the purpose of ventilation; with the first, the galleries are systematic, and at certain distances, and their object is as well the winning as the hauling and ventilating. By the second method, the winning of the coal during the preparatory work is always sacrificed to the hope of obtaining an important quantity at the winning of the pillars. By the first plan of working, all that is to be won from the strata is occasionally obtained from the commencement.

3. *Working with long pillars and with supported galleries.*—A uniform process is adopted in very many mines of the provinces of Luettich and Mamur, and consists in driving galleries parallel under each other and in different directions, which are supported by timbers or masonry, and between which pillars are left standing until a partial or complete rape or clearance takes place.

4. *The ascending work, or winning with broad cuts*, which, in its application, is very various, and by means whereof the coal is won from a great breadth, whether from the shaft or from the end of the mining field, and towards the shaft. The ascending work is found in Couchant-Revier of Mons, in the Ruhrbeken, in Lower Silesia, and in England.

5. Finally, a last system, which appears to take its place between the two foregoing, is distinguished by the general term of *stoping work* (overhand). It is employed in the centre of Hennegau, at Charleroi, in several of the mines in the provinces of Luettich, and on several of the standing strata of the Ruhr district.

Strata of great magnitude occasion the following division:—

1. The old method, with *galleries, pillars, and posts*, which, on account of its imperfections, has almost every where been abandoned.

2. The so-called *cross work;* that is, with galleries driven crossway on the strata, whilst advancing from the hanging to the underlaying ground, and the opposite. (Creuzot, St. Etienne, Montchanin, &c.)

3. With *horizontal and successive storywork* ("Stockwerkbau"), which method is employed at Rive-de-Geir, St. Etienne, &c.

4. The process adopted at Staffordshire, with *compartments or isolated chambers*, and with stationary safety pillars.

5. *With several successive stories*, which are so worked at

various times as if the mass consisted of a double strata, the upper bank being first won, and then the under one. This process is employed in the mighty strata of Upper Silesia, and at the working of the St. Lucien strata at Blanzy, in France.

6. The process by means of *tumbling-work*, which is adopted at Epinac, in France.

7. The process heretofore customary at Rive-de-Gier, but now abandoned, by which the movements of the laying ground are used for the winning of the strata in two banks.

COMPARISON OF THE DIFFERENT METHODS FOR WORKING.

The long pillars, it seems, must be preferred to the oblong square short pillars; for the former better counteract the strong pressure of the hanging layers, and the coal is less affected, so that more coarse coal falls at the winning. Whereas, with the short pillars driven through, with cross galleries, just the reverse takes place, and a great quantity of dust coal falls, which, under certain circumstances, has no value at all. In Germany, therefore, they seek as much as possible to decrease the weakness of the pillars in coal working; and every where, on following this system, good results have been obtained. Both systems may be employed on all strata, let their inclination be what it may; but if they are weak the pillar work is disadvantageous, and the ascending work should be adopted.

The most important disadvantage of the long as well as of the short pillars, consists in the crushing of the coal by the pressure of the hanging ground, and their partial destruction when too long a time elapses between the preparatory works and the rape of the pillars. When the formation of the hanging ground every where admits of the winning of the pillars, then dust coal almost only is obtained. To avoid these disadvantages, it is merely necessary to bring the preparation of the working field into conformity with the surrounding formation.

Long pillars and working places with supports offer more advantages. The first are never intersected by ventilating galleries. A preparation with sufficiently broad cuts requires comparatively, less labor than galleries, the sections of which must not exceed certain limits. The galleries or cuts are thus from the commencement winning works in reality. This process, however, with which from the very onset at the strata a winning takes place, has nothing to induce the miner to adopt raping. A greater mining field is always prepared; and when it becomes so extended that the hauling and hoisting grows tedious, it is then time to think of winning the safety pillars which have been thus long left standing. During this long time this hanging ground becomes displaced, the pillars crushed, the galleries ruptured and blocked up, the laying ground broken up, so that the miner sees

himself obliged to drive some galleries crossways through the pillars (so-called through cuts), or to allow them to stand entirely. In addition, the long pillars require very expensive maintenance, and the ventilated air, at the same time, becomes foul long before it ascends from the shaft. The laying out of the working field into a number of divisions of a limited surface would suffice for the avoidance of all these detriments. The Luettich miners, however, are accustomed to adopt new systems, not content with perfecting those customary for several centuries past.

The ascending work is that which appears to be most practical for the mining of strata, the magnitude of which does not exceed 1.80 met. or 69 inches. Beyond this highest mark, the bulk of the support is not in proportion to the space of the workings. In any case, the hanging ground must possess sufficient solidity, or this method will not be at all practicable, as frequent attempts at the coal mines in the centre of Hennegau have conclusively shown.

The ascending works customary in Belgium consist of several workings of minor height, which lie alongside of each other, and the stopes of which simultaneously recede from the strata; that is, from the confines of the prepared working field to the shaft. From this circumstance it must not be inferred that they require a greater number of slits than the ascending stopes in England and Silesia, which develope themselves in an extended straight or curved line. The stope receives, at short distances, vertical slits, which facilitate the winning of the coal. Under both circumstances, therefore, the labor is the same, and the quantity of the coarse coal does not depend on the kind of work but on the solidity of the strata. The stoping work is requisite in Belgium, on account of the lesser solidity of the hanging ground, which cannot remain unsupported for large distances.

Large workings are very profitable; not the slightest loss of coal occurs; the direction of the ventilating draft is very simple; the hauling and hoisting easy, &c. Among all the various modifications of which this winning system is capable, the back-work seems to be the most available in all those cases wherein its application is possible. The miner thereby learns to know all the conditions of the formation, for instance, the dislocations, before he commences real productive operations; he can arrange his workings beforehand in such a manner that the hauling and hoisting is never interrupted; he is never surprised with unforeseen occurrences. The galleries become shorter in the same degree that the winning proceeds, and require, therefore, less repairing. The ventilating current is divided into as many parts as the mine contains workings; finally, the breaks are of trifling importance, as it is quite immaterial whether the point at which they show themselves remains attainable or not.

When the bad condition of the formation of the "country"

does not permit of the ascending work, or great winning stopes, one must have recourse to the real stoping work; that is, to successive or parallel workings. Its small surface shields it partially against breaks; and as it, proceeding backwards, gradually returns to the shaft, it offers many of the above-named advantages. This winning method has, however, important disadvantages; viz., a small hauling and hoisting, a consequence of the single and narrow workings, and the necessity of attacking the strata, not only at several points, but also several strata at one time, in order to meet the demand for hauling and hoisting. For this reason several galleries must be opened, the maintenance of which is very expensive.

In regard to the working of thick strata, the process with pillars, galleries, and posts, which is yet followed in several mines in Scotland, as also in working single fields, as in Staffordshire, is accompanied with an important loss of coal, or the winning is very impure, as it is necessary for the safety of the hanging ground, and to the keeping of the galleries, to leave coal pillars standing. The working with supports, which has been introduced into mines, is adopted where a canal, a stream, or thickly populated town, do not admit of disturbing the upper surface; yet it is often very difficult, and attended with vast expense in obtaining a sufficient quantity of rock. The method employed at Epinac combines favorably with regard to economy of labor and purity of the winning. But the hanging ground must be sufficiently hard in order to remain for a time standing; then it breaks, sinks down on the laying ground, and fills up the working. The working with stories, or floors advancing from the top downwards, which has in its favor the fact of being practised for many years in Silesia, and which was also tried at Blanzy with such good results, appears to be so favorable to the working of powerful strata, that it is recommended by distinguished miners not only for the winning of horizontal but also of very strongly inclined strata.

CHOICE OF A MINING SYSTEM.

The various methods for working coal were not the result of an invention, as other industrial processes; on the contrary, the original, often crude modes of operation, have gradually become changed and perfected, according to the local influences, which have an important bearing on the whole, and on the particulars of mining. Hence arise the innumerable divisions and subdivisions of the systems, which are found in the descriptions of the various coal districts.

No experienced and reflecting miner will be of the opinion that any one mining system should be preferred to the exclusion of all others. He would thereby soon meet with great difficul-

ties; as one method, which, for a certain locality, would be very practicable, would be for another, on the contrary, very impracticable. But as it, on the other hand, would be found very inexpedient to select for each case that offers itself in practice a particular system, the intelligent miner should never choose blindly, but he must have an exact acquaintance with all the systems, and take that which best suits the character of the formation of the strata to be wrought. In this manner the object is attained which he must constantly keep in view, viz., *to win from a certain space as much coal as possible with the least expense, and preserve thereby a due regard to the maintenance of the works and the safety of the workmen.*

The choice of a method for any particular mine, should neither depend on accident nor should it be left to the discretion of the mining superintendent; he should take into consideration all the local conditions, in order to select those circumstances which are the most favorable to the working. Therefore the magnitude, and then the inclination of the strata, as the most influential elements, should first receive the attention of the miner; then the size of the working field, the possibility of a clear or only a partial winning, and the solidity of the hanging and laying ground. On the last condition depends mainly the possibility of retaining the workings for a longer or shorter time open. Further, regard must be paid to the curving of the layers, their dislocations, the development of gases, the quantity of material for supports, a number of other circumstances, the enumeration of which here would lead us too far. He must compare the amount of wages for mining with the price of the materials for the security of the workings, and with the coal to be won. If all those mining methods, which evidently bear no conformity to influential circumstances, be disregarded, the miner finally attains a knowledge of a system, which, in its general character, is adapted to the most essential natural conditions. If he be acquainted with the working methods employed in different parts, he will avail himself thereby of only that which is practicable and applicable to the local conditions, yet always only experimental, and with the necessary changes according to the other locality. If a new mine is to be opened in a coal basin already worked, the choice of a method is much facilitated; then, as far as possible, that process must be employed with which the miners are already familiar, and only the most necessary alterations be made; for it is a very difficult matter to change the fixed habits of the workmen, and introduce new working methods. Each alteration of this kind must be well reflected on, as every mining process that has been long customary rests on very positive grounds, to the full comprehension of which a perfect knowledge of the local condition is requisite.

If, on the one hand, it be impossible, of which one may be-

come soon convinced, to prescribe general rules for the choice of a working system, the principles for the special branches of the mining process are more definite; and the miner dare not, without detriment, depart therefrom. We must therefore make here a brief mention of them.

THE SHAFTS AND THE CROSSCUTS.

The hoisting shafts are so placed that they divide the bearing of a mining field into two almost equal parts. As regards their position to the underlay, if a strata inclining under 45 degrees is opened by a shaft at a deep point, the gallery hauling may be effected downwards to the shaft. Very steep, inclining, or zigzag curved strata, require a sinking of the shaft in the middle of the working field, and the process with crosscuts towards the two opposite points of the horizon.

A very general rule is, to let pillars stand all around the shaft in every strata, in order to secure the ground against breaks. Some English mining engineers, however, entirely disregard these rules of precaution, preferring a uniform breaking of the whole mining field, for which reason the entire strata is worked out. But, as experience has proved the effect of these natural props, and as, at a break of the timbering and masonry, the whole neighboring ground caves down, it is much more advisable to follow this general custom. Pillars, at the utmost of from 10 to 15 fathom radius, are, however, under all circumstances, sufficient.

The crosscuts penetrate the strata in the shortest line; decrease also the length of hauling, and of the ventilation. But, as the crosscut process is very expensive, the miner seeks, if possible, to avoid it, and, by an exact study of the formation of the strata, to perforate several with a single crosscut.

[To be continued.]

ART. III.—A REPORT ON THE ECONOMIC VALUE OF THE SEMI-BITUMINOUS COAL OF THE CUMBERLAND COAL BASIN, &c.*—By ROBERT G. RANKIN.

THE late David Mushet remarked that it was the very best bituminous coal he had ever met with, and considered it well adapted to iron making. Three specimens of the *iron ore of this region* were at the same time reported upon by Mr. Mushet; the results of his analyses were as follows:

* Continued from page 60.

Brown fibrous hematite of excellent quality yielded of best cast iron, ...	62·6
Common argillaceous iron stone of the coal measures yielded, ...	34·3
A very fine argillaceous stone yielded of best cast iron, .	41·4

While writing this report an official report from Mr. Sherman (who, in company with Mr. Bloodgood, visited the mines of the Cumberland Coal and Iron Company), appeared in the New York Herald of the 21st of February, 1855, stating that large deposits of *black band or iron-bearing stone* had been discovered in the roof of the big vein. The report is accompanied with a chemical analysis of the ores, showing the following results:

Specimen No.	1	42·38	per cent. of iron.
"	2	23·81	"
"	3	4·89	"
"	6	33·60	"
"	7	9·10	"
"	8	9·57	"
"	11	25·20	"

or an average of 21·22 per cent. of iron on the specimens analyzed.

It is not intended to enlarge upon the well-known deposits of iron ore, in its various forms of combination in these coal measures. The wide difference in results between the delicate manipulations of a chemical test and the practical developments of the furnace, and the reported analysis of Mr. Sherman, only verify what has been said before, that the value of these coal measures is not yet practically and scientifically known.

If the proper examinations and *practical* experiments through the furnace verify the report of Mr. Sherman, the Aspinwall purchase and Ravenscraft properties have the same augmented values with the Cumberland Company's mines; the two purchases having over five square miles of the same roof of black band.

OF THE QUANTITY OF COAL IN AN ACRE OF LAND.

As before stated, erroneous estimates have been made by some parties of the quantity of coal in a given district, by adding together the total amount of coal in all the seams workable and unworkable. It may be positively asserted, that the exact continuous order of superposition, area, number, and thickness, of the various seams of coal, iron ore, sandstones, limestones, clay, conglomerates, &c., have not been ascertained, for the reason, as before stated, that no scientific and geognostic instrumental survey has, as yet, been made. The reports of the Messrs. Silliman, Rogers, Ducatel, Shepherd, Owen, Taylor, &c., have been the

only reliable reports, and all these differ in important particulars, and were made under varying degrees of facility for observation and exploration. These differences have afforded unscrupulous parties an opportunity of presenting plausible estimates of "unknown quantities;" of locating veins "*thick* and *thin*" to order, as might be wanted to suit purchasers, with the unfailing conclusion, *that just such a particular spot, and only that spot, contained the biggest quantity of the "Big Vein," purest coal and no slate; that the coal was of the self-mining, self-delivering, costing-nothing kind*, and that no other spot had the same; like the newspapers, "no other paper had the same news." Taylor, in his "Statistics of Coal," appears to have formed the most judicious estimate of the quantity in the Cumberland basin, and extracts from his work on this point are presented. He says, "The topographical details of the published maps differ so much, that it is quite *impracticable to be precise in estimating the areas* and subdivisions of the Maryland coal regions. The *external boundaries* of the entire field are sufficiently defined; we are not so certain of the interposing areas of the subordinate rocks which divide the district into at least three portions. The geologist of the State appears to have experienced the inconveniences consequent upon so imperfect a topographical survey. In the report of 1836, the Frostburg coal area is stated to be 180 miles square. In the report of 1840 the area is given as 90 miles, and in another statement at 135 miles. Our own admeasurement is 150. From among the various reports, public and private, of the Maryland coal region, or, more properly speaking, of the Frostburg or Cumberland portion of it, for of the back country we know very little indeed, *we cannot possibly determine the number of workable coal beds, even in the best explored parts of the latter district.* "The corrected Lonaconing section, Plate III. of the State Geological Report of 1840, exhibits six workable seams, which have an aggregate thickness of 35 feet; the other four seams amount to only 6 feet. Below this 35 feet series, viz., from Lonaconing down to Westernport, 25 feet of coal are known, but are chiefly made up of seams, of which about 15 feet are workable. From these data we make out 50 feet as a maximum workable coal of the Frostburg region, but according to Dr. Ducatel, not more than 45 feet can be calculated upon. "Portions of the areas of the lower beds are destroyed by the erosion of the valleys, the lateral ravines have also largely subtracted from the areas of the lower beds. It was the knowledge of these extensive denudations and removals, especially in the most mountainous portions of the coalfields, and in those districts where the coal formations undulate, that gave rise to our previous remarks on the necessity of *making large allowances for barren or inaccessible ground when calculating coal areas.*" We could point out considerable districts towards the northern termination of this Alleghany coalfield, where certainly not one acre in ten, and often,

not one acre in a thousand, contains a bed of coal in a workable condition, or even a single ton of that material!! Mr. Taylor, in speaking of the claims of interested parties of the superiority of such particular locations, says, "We continually meet with the unreserved and unqualified assertion of these claimants, that the coal of their particular mine or district, *no matter where*, is the best yet discovered for every practical use. Now, as *they cannot all be the best*, it follows that a good deal of exaggeration prevails in some of these cases." However, the test of science restores all things to their true value; the examinations of Prof. Johnson in 1844 have dispelled many illusions, and have assigned to all their appropriate place in the catalogue, *and here the Cumberland coal takes the very highest place in the series in the order of evaporating powers.*

The thickness of the big vein has been variously estimated at 9, 10, 12, 14, and 15 feet. Its actual thickness at the openings in the Aspinwall purchase is over 14 feet, and one of the pillars taken from the mine, and now standing in the court-yard of the Crystal Palace, New York, shows that height.

The openings on this Aspinwall purchase present a beautiful sight. On entering the mine, you behold the coal, and nothing but coal; above, below, and at the sides, clear, bright, glistening surfaces, without slate, or break; nothing but the real, pure black diamonds, seemingly inexhaustible. The value, existence, position, direction, and continuity of this coal purchase have been accurately determined by explorations. For convenience in working economically, 12 feet only should be allowed for workable coal. The specific gravity of this coal is 1.552, and a cubic yard weighs 2,619 pounds. Each square yard of the floor of the mine should be covered with 4.67 tons (2,240 lbs. each) of coal, which gives 22,602.80 tons per acre. In the large seams, it is not usual to excavate the whole mass of coal, portions of the roof being left for subsequent operations. The pillars of coal to support the roof are also left, and in the course of operations much fine coal is made, which is generally made into coke. For these reasons, a deduction of at least 40 per cent. should be made from the above yield per acre, and there would remain the actual quantity of 13,561.68 tons per acre, or say, in round numbers, 13,000.* The above calculation is based on the assumption that the bed maintains the continuity and uniformity of thickness which actual experiment has demonstrated to be the case on the portions of the Aspinwall purchase and Ravenscroft properties, penetrated by the "Big Vein." It will be seen that no calculation is made of the other or smaller veins.

When the "Big Vein" is worked out by the present and future generations, the smaller veins will undoubtedly be taken

* These numbers will not suit the coal speculators, some of whom have *guaranteed* 45,000 tons per acre.

[illegible]

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into consideration. It is true the smaller veins are worked profitably in some localities, but at a diminished profit, the expense of miners' wages to excavate a ton from a small vein at the present rate of labor being about 88 cents, and from the big vein 35 cents.

ANALYSIS OF THE COAL AND ITS USES.

Coals are generally divided into the following kinds or classes.

1. *Fatty, bituminous*, adhesive, caking coals, generally burning with strong lively blaze, swelling in the fire, choking the grate and draught. These features characterize the coals of the Western Alleghany basin, and the Newcastle, Staffordshire coals of England, and most of the Scotch coals. These coals are used in the manufacture of gas, the carbon in them varying from 39 to 70 per cent., and volatile matter from 38 to 56 per cent.

2. *Dry* coals, burning openly and freely, with lively blaze, but not so adhesive—very like some of the Alleghany coals—they contain about an average of 36 per cent. of carbon.

3. *Very dry* open burning coals; non-caking or non-cementing, yet forming a beautifully bright and lively coke, swelling some without choking draught—are *semi-bituminous*, and contain an excess of carbon, averaging about 81 per cent. These coals are found in Wales, France, Saxony and Belgium, and Maryland, Virginia and Pennsylvania. They are known in the English navy as "*Steam Coals*," from their superiority in generating steam. These coals burn easily, without smoke, and do not deposit soot or incrusting matter in chimneys or flues.

4. Anthracites or non-bituminous coals, containing 85 per cent. of carbon, and burn without flame.

The semi-bituminous coal of the Cumberland region falls within the description of class 3d.

From the various analyses of this coal, it appears to rank highest in the scale for evaporating power; and for generating steam in our *high sea steamers, has no superior*. Its composition shows its exemption from all danger of spontaneous combustion, moisture does not impair it, and its greatest liability to disintegration arises from exposure a great length of time to a hot sun.

The various analyses of this coal by Dr. Ducatel, the Messrs. Silliman, Johnson, Rogers, Chilton, Cassils, Hayes, Jackson, Jones, Davis, Renwick, and Percy, have been averaged, and the reduction shows the following average of its constituent elements:—

Specific gravity.	Carbon.	Volatile matter.	Ashes.
1.4630.	75.92.	15.86.	9.23.

It should be remembered that the above results are the average of the basin, but in confirmation of what has been before stated, in this report, as to the difference in the quality of the coal in

the basin, the following maximum and minimum analyses under each head is given:—

	Specific gravity.	Carbon.	Volatile matter.	Ashes.
Maximum,	1.584	85.00	22.50	18.32
Minimum,	1.291	66.30	9.47	2.99

The coal from the immense beds belonging to the Aspinwall purchase has a specific gravity of about 1.552, and contain about 85 per cent. of carbon.

Of its value as a steam generating element, some idea may be formed from the following statement and comparative table.

The generating power of English and American coals, may be estimated by the quantity of water in pounds, at 52 degrees of Fahrenheit, converted into steam at 220 degrees by one pound of fuel. The table shows, in connection with the preceding one (of the composition of the coals), that the Cumberland coal, in its amount of carbon, exemption from sulphur or erosive matter, and for evaporating power, ranks among the first for steamers' use.

Comparative steam generating powers of

Dry Pine wood,	3.10 lbs.
Dry Oak,	4.85 "
English Staffordshire coal,	6.04 "
Splint coal,	6.75 "
American Anthracite,	7.00 "
Coke prepared in close vessels,	7.70 "
Ordinary Newcastle coal,	7.90 "
Best Wallsend,	8.60 "
Frostburg or Maryland coal (less than),	10.00 "

The next table exhibits the weights of a cubic foot of the ordinary woods and coals in general use, and may perhaps aid in a more careful estimate of the future value of our American coals for our locomotives, and steam generating powers generally.

The weight (without fractions) of the woods is reduced from their specific gravities; the weights of the coals show their weights according to their specific gravities, *or their solid weights in the mines*, and also their marketable weights or weight in the coal-yards. It should be remarked, that green wood contains forty-two per cent. of moisture; and that the weights of all the woods in the following tables are taken in their dry or seasoned state (except those with a * prefixed), and it takes 13¾ per cent. of the heat that burning green wood produces, to convert its contained moisture or water into vapor, and expel it. A cord of wood is generally measured at 128 cubic feet, but for scientific analysis a deduction of about 12½ per cent. should be made for the kerf at the ends of the sticks.

Woods.	Weight of cubic foot.	Coals.	Weight of cubic foot in the mine.	Weight of cubic foot in market.	Number of cubic feet of space to stow a ton.
Ash	52	Maryland .	89.44	53.70	41.71
Birch	23	" .	83.28	54.29	41.26
Elm	41	" .	82.09	52.92	41.90
White Fir	35	" .	88.40	53.29	42.33
Hacmatac	37	Blossburgh	82.73	53.05	42.22
Live Oak	70	Anthracite	91.51	53.79	41.64
Maple	46	Lehigh .	99.39	55.32	40.50
Yellow Pine . . .	41	Picton .	82.35	53.55	45.82
White Pine	33	Sidney .	83.66	47.44	47.22
Dry Pine	21	Liverpool .	78.89	47.88	46.78
*Common Dry Hickory	46	Lackawanna	88.84	48.56	45.82
*White Oak	42	Newcastle .	78.54	50.82	44.08
*Soft Maple . . .	40	Scotch .	91.95	51.09	43.84
*Chestnut	22	Cannelton .	79.54	47.65	47.01

By multiplying the weights of each of the woods by 128, the weight per cord of each kind will be obtained. The bituminous coals will average about forty-two cubic feet to the ton for stowage (for instance, in a locomotive tender), and about twenty-nine bushels make a ton.

CUMBERLAND COAL FOR LOCOMOTIVE USES.

It has been stated that the use of Maryland coal is entirely practicable for locomotive purposes, both in its raw or crude state and coked form; and its use on our railroads is gradually increasing.

It may be confidently stated that prejudice, and not unfitness, has hitherto prevented its general use on our Northern roads. As an illustration of the economy gained by the use of these coals over wood, an example may be taken from the tables. It is assumed that locomotives *can be made or adapted* to the profitable use of this coal for passenger and freight transportation; and the non-use of it in Northern locomotives may be attributed to prejudice or a mistaken economy, *an economy without profit.*

The best evidence of its utility is the daily and actual use of it in the "Camel" and other engines on the Pennsylvania and Maryland roads, and the report of J. White of its use on the Norwich and Worcester railroads.

In the table, Live Oak has the highest density on the list; but as this is not to be obtained in our northern latitudes for locomotive purposes, we take a wood more commonly used—*Dry Oak.*

The weight of a cubic foot is 42 pounds, which, multiplied by 128 feet to the cord, gives 5,376 pounds of fuel per cord; and this product multiplied by 4·85, its evaporating power, gives 26,073·60 pounds of steam. The average of the four results of the table op-

posite Maryland coal gives the weight of a cubic foot of 53·55; this multiplied by 128 per cubic foot, gives 6854·40 pounds of fuel; and this product, multiplied by its evaporating power, gives 68,544 pounds of steam; or, in other words, 128 cubic feet of oak wood weighs 5,376 pounds, and makes 26,073·60 pounds of steam; and 128 cubic feet of Maryland coal weighs 6854·40 pounds, and makes 68,544 pounds of steam. The increase, with equal bulk, is 162 per cent.; the increase, with equal weights, is 106 per cent. It is a ruling point in railway science to give to the engine all the tractional power possible, and to throw off all superfluous weight or all dead weight. A portion of the engine's power and time is expended in drawing its own fuel and water; and if, by the use of coal, a reduction can be made in the size, cost, and weight of tender and fuel, an important point is gained. An ordinary tender has a capacity for wood of about 160 cubic feet, and, if heaped above the combings, may contain say 180 cubic feet, or one and a half cords of wood.

This one and a half cords of wood would make 39,110·40 pounds of steam; and the same number of feet of Maryland coal would make 102,816.00 feet of steam. The distance to which the respective quantities of steam would drive the train being determined by the velocity of the piston.

The following testimony of C. Slack, Esq., the proverbially accurate and capable manager of the Cumberland and Pennsylvania (commonly called the Mount Savage) Railroad, is in point:

"Later experiments on the Baltimore road than those conducted by Mr. Murray, confirmed the general accuracy of his examinations touching the comparative economy of wood and coal. Those I refer to were made in engines of different class and construction, which raised the quantity somewhat, *but the general fact was well established, that a ton of Cumberland coal would evaporate as much water as* 2 *to* 2¼ *or even* 2½ *cords of Pine wood.* No trial, to my knowledge, indicated less than two cords of wood to a ton of coal. Considering the enormous sum that is paid for wood by Northern Railroad Companies, and the preponderating character of that feature of their expenses, it is a matter of surprise that they do not use coal exclusively, with their freight engines at least. I have seen the statement, that some of the companies pay as much for a cord of wood as would buy a ton of coal. With such a fact before them, I should think they would at once change their furnaces to burn the Cumberland coal.

Description of first-class Locomotive Engine in use on the Cumberland and Pennsylvania Railroad. Ross Winans, Baltimore, builder.

Diameter of Cylinder	19 inches.
Length of Stroke	22 "
Diameter of Wheels	43 "
" " Boiler	47 "

Length " "		$23\frac{9}{12}$ feet.
Number of Tubes		103 "
Length " "		$14\frac{1}{12}$ "
Diameter "		$2\frac{1}{4}$ inches.
Area of Fire-box	90 feet.	
" " Tubes	860 "	
" " Firegrate	24 "	
Depth of Fire-box below tubes		26 "

Weight of Engine and tender . . 30 tons, and will consume, in a run of 60 miles (average grade 105 feet per mile), $2\frac{16}{20}$ tons of coal.

C. SLACK, *Superintendent.*

Note.—The length of road is 15 miles, and the "run of 60 miles," spoken of above, is the usual day's work of two round trips. As the power is not used in descending, of course the consumption of fuel occurs almost exclusively in the two ascending trips. The usual load is 30 coal cars, weighing three tons each.

FOR HIGH SEA AND RIVER STEAMERS' USE.

For steam navigation the standard rank of coal is that which gives the highest evaporative powers under given bulks.

The coal-bunkers of a steamer can contain but a given number of cubic feet of coal; and, consequently, that coal which produces the most steam per cubic foot is the most valuable, its non-erosive qualities being duly considered.

The Maryland coal holds this rank, when *burnt in properly constructed boiler furnaces,* as from the tables we see that one cubic foot produces 573 pounds of steam. The residuum of ashes is only about $2\frac{3}{4}$ pounds of ashes to every 100 pounds of coal. The daily (although imperfect) use of this coal in our steamers, and its well known power and non-liability to spontaneous combustion, are facts within the knowledge of most readers. Its use in steamers will be vastly increased when boilers are constructed suitable for its perfect combustion, and attention is requested to a few practical remarks on the combustion of coal in another part of this report. A thorough practical knowledge of the true method of raising steam from this coal in our steamers is yet to be acquired; and it is hoped that less time will be required for the acquisition of such knowledge than was requisite to introduce the anthracite in our factories, furnaces, and dwellings.

For *ferry boats* it is particularly valuable, as it almost supersedes the use of wood for kindling fires. On laying up for the night the fireman has only to throw on his fire some slack or fine coal, open his furnace door, and leave it for the night. In the morning some fresh coal and the poker gives him a *steam* fire in a few moments without a particle of wood.

FOR BURNING BRICK.

The use of the Cumberland coal for making brick has been practically demonstrated, as may be seen by reference to the

Mining Magazine, Vol. III., pp. 110–228. The kiln does not materially differ from one where wood is used, except by the introduction of air chambers between the fires, and additional facilities for air under the grates. With moderate caution in its use, at first, brick burners will, after a short trial, give it a preference over all other fuels, for the following reasons: The heat is got up, the water expelled, and shrinkage obtained in about one half the time required by wood fuel, *say a saving of over* 40 *per cent. in time.* It is generally estimated that one cord of wood will burn 3,000 brick, or 33⅓ cords for 100,000 brick, and the average *daily consumption* of wood is about 7 cords to 100,000 brick, requiring 120 hours to burn a kiln. Now, one ton of Cumberland coal will burn five to six thousand brick, or say 20 tons of coal for 100,000 brick, consuming about 6 tons *daily*, and requiring 84 hours to burn a kiln. Assuming the cost of a ton of coal and a cord of wood at the same price, *the saving in fuel is* 40 *per cent.* The saving in labor, by reason of the greater facility of handling the coal is also very great, which, added to the compactness for transportation and certainty of market, *makes the Cumberland coal superior to all other fuels for burning brick.*

FOR FORGING PURPOSES

this coal holds the first rank, as it ignites rapidly, burns with a deep red flame, cements into semi-solid masses, producing a strong heat without much flame or smoke, and but little cinder.

FOR DOMESTIC PURPOSES,

Professor Johnson says, "it possesses, on the one hand, a flame abundantly sufficient to give cheerfulness to the aspect of a parlor fire, and on the other hand a durability approaching that of some of the lighter anthracites." Its tendency to agglutinate and swell prevents its falling through the grate bars. Much disappointment has been experienced on the first trial of this coal, in attempting to burn it in ill-adapted grates. The bottom bars of the grate should run at right angles with the longitudinal axis of the grate, and the upper front bars should project over the lower front bars, to allow for the swelling of the coal. The grate should be large and circular at top, and narrow or small at the bottom, shaped like the frustum of a cone (base upwards), flattened to an ellipsoid form. The coal requires freedom for the admission of air; and when its use is understood, *will rank among the first of our American coals for parlor purposes.*

ON THE COMBUSTION OF COAL.

The sagacious and comprehensive mind of Watts developed and matured the elementary principles of the Steam Engine, and

it is believed, that beyond the improvements in its manipulations, the steam engine of the present day is substantially the engine of Watts, as perfect then as now; the modern application of his developed principles do not affect the position.

The production of steam is involved in the true expression of a *chemical union* of certain elements, in the process of combustion; and although this chemical union is now better understood by men of science than in the days of Watts, yet in practical life there is but little practical knowledge of it.

This truth is verified in the endless and constantly varying forms of boilers, furnaces, flue surfaces, grate surfaces, &c., forms, modified, altered and educed, not from principles of science, but notions and crude experiments, and looking more to the *application* of the heat, than to the *extrication* of the heat from the combined elements that may produce it.

It is assumed by many, that all that is essential to produce steam, is to heap up the coal on the bars of a *favorite* furnace, and the steam must come; forgetting that the principle of combustion, or the extrication of the heat from the coal is as essential as its application.

When the true principles of the combustion of coals is made practical, our steam engines will be driven with an immense saving over the ordinary consumption of fuel.

Combustion, according to Ure, "is the disengagement of heat and light which accompanies chemical action," the union of inflammable substances with oxygen; i. e., the disengagement of caloric, and *absorption of oxygen.*

The absorption of oxygen, or *proper mingling of the oxygen of the atmosphere with the gas from the coal*, is the real seat of power in the coal. The practical knowledge of *this truth*, and a practical application of it, would save millions to the steam marine of the world.

To evolve the full power of the coal, the oxygen of the atmosphere must be allowed to exercise its legitimate friendly effects, instead of excluding it as an enemy of combustion, and its virtue will be found only when properly commingled with the gaseous and carbonaceous elements of the coal.

The most practical writer of the present day on the combustion of coals, is C. W. Williams, Esq., the managing Director of the City of Dublin Steam Packet Company, whose late work on this subject should be in the hands of every engineer and boiler maker. His actual experiments, scientific acquirements, and practical experience, are the principal authorities for most of the positions on this subject contained in this report, and given mostly in his own language. He says, effective combustion for practical purposes is, in truth, a question more as regards the *air* than the gas. Besides, we have no control over the gas as to quantity after having thrown the coal on the furnace, though we can ex-

ercise a control over that of the air in all the essentials to perfect combustion. It is this that has done so much for the perfection of the lamp, and may be made equally available for the furnace. Yet, strange to say, in an age when chemical science is so far advanced, and in matters so purely chemical, this is precisely what is least attended to in practice. The *how*, and the *when*, and the *where* this controlling influence over the admission and action of the air is to be exercised, are points demanding the most serious consideration, and can only be decided on strict chemical principles."

The first product on the combustion of bituminous coal is gas, the result of the absorption of heat by the coal. The constituents of this gas are hydrogen and carbon. The hydrogen, by the heat, separates itself from the carbon, and uniting with the oxygen of the atmosphere, forms water. The carbon unites with oxygen in three proportions, forming *carbonic acid*, *carbonic oxide*, and *carbonous acid.*

This carbonic oxide, the formation of which in the furnace is *wholly unheeded* in *practice*, exerts a very considerable influence on the quantity of heat obtained. Carbonic acid is a compound of one atom of carbon with two of oxygen; carbonic oxide of one atom of carbon with one atom of oxygen. Carbonic oxide is one of the most waste-inducing compounds of the furnace, unless provided with its equivalent volume of air by which its combustion will be effected.

Air, on entering from the ash-pit, gives out its oxygen to the glowing carbon on the bars, and generates much heat in the formation of carbonic acid. This acid necessarily, at a very high temperature, passing upward from the body of incandescent solid matter, takes up an additional portion of the carbon, and becomes carbonic oxide.

Another peculiarity of this carbonic oxide is, that by reason of its already possessing one half of its equivalent of oxygen, it inflames at a lower temperature than the ordinary coal gas, the consequence of which is that the latter, on passing into the flues, is often cooled down below the temperature of ignition, while the former (carbonic oxide) is sufficiently heated, even after having reached the chimney top, and is there ignited on meeting the air. This is the cause of the red flame often seen at the tops of chimneys and the funnels of steam vessels.

The waste of this steam-generating element is enormous on our American river boats as well as in our furnaces, and its prevention is a subject intimately connected with our economics.

Ten cubic feet of unvitiated air are required to supply two cubic feet of oxygen, to effect the combustion of one cubic foot of coal gas, and consequently this proportion of unvitiated air is required not only for the combustion of the solid carbonaceous portion of the coal on the bars, but to the gaseous portion on the

furnace; if the whole supply is compelled to pass, as is usually the case, through the ash-pit, the required condition is unfulfilled: the requisite amount of air should be supplied to the gas generated in the upper part of the furnace, as well as to the solid carbon resting on the bars.

The weight of fuel to be consumed has no legitimate relation to the space on which it is laid, and depends on other considerations, viz., on the quantity of air passing through it, the time employed, and the weight of oxygen taken up by the several constituents of the fuel respectively.

In the process of combustion, these two bodies present themselves, one a solid, the other a gaseous body, and each requires distinct conditions. These conditions are, the *superficial area of the grate* surface, the other, *the sectional area of the chamber above the fuel.* The former should not be too large, requiring no more space than is actually covered by the coal *at a given depth;* the latter should not be *too small*, requiring, as it does, room for a gaseous body and its rapidly enlarging volume.

(To be continued.)

ART. V.—SILVER, AND THE PRESENT STATE OF ITS WINNING FROM ARGENTIFEROUS ORES.—No. 2.*—BY ALEX. TRIPPEL, METALLURGICAL CHEMIST.

THE physical and chemical properties of silver justly entitle it to the name of a precious metal. The color and brilliancy of articles of silver, the agreeable change of their polished from unpolished surfaces, is far more gratifying to the eyes than that of articles of gold. With the exception of this latter metal, silver surpasses all others in ductility and pliancy, while its hardness and fusibility is such as to allow of its use for any artistical work or domestic utensil. The lustre and color of silver is not changed by moisture or air, and it resists all vegetable and some mineral acids. So many excellent qualities augment the worth which has been attributed to this metal as a means of exchange for thousands of years. Although the poetical expression of silver age, in as far as this means the successive discovery and application of metals, is an anachronism, because copper was undoubtedly known long before, still the application of silver reaches back earlier than the annals of history. Gold, scarcely secreted by the gravel of destroyed mountains, attracted, by its color, lustre, and weight, the attention of man when he entered upon the virgin earth. Copper, too, is found in a native state in considerable masses on the surface of our globe; but the winning of silver pre-

* Continued from Vol. IV., page 47.

supposes advanced metallurgical skill, for it is concealed in its ores, combined with other metals, from which it has to be separated before it manifests itself. It seems that native silver has not become known until in later periods, because it is found deep under ground, and rare, though in some instances in considerable masses. The general large extension of minerals yielding more or less silver, as sulphuret, arseniate, etc., compensates for the scarcity of its native appearance; and all the quantities of gold found in all parts of the globe are but little, if compared with the enormous masses of silver produced, mostly from poor argentiferous ores.

If all the ores from which silver can be extracted were considered as silver ores, they would comprise a great part of lead, copper, zinc, antimonial and arsenical ores,—sometimes even the iron pyrites as such, as they all have been already used as such. A clear distinction is, therefore, difficult, if we do not agree to call silver ores only a few mineralogical species, where it exists in quite a considerable quantity. The metallurgist, in his practice, must adopt another plan for his classifications; he merely considers the quantity of silver in argentiferous ores, and determines, guided by local circumstances, whether the silver will be the main product, or a matter of secondary importance. It should be remarked, however, that in some cases the partial or total loss of copper or lead is preferred, if by this sacrifice the silver can be brought out completely, as the latter has 60 times the value of copper, and 250 times that of lead. But even if the more special silver ores are the object of metallurgical treatment, they will be found mostly with the silver sparsely sprinkled in the gangue, and consequently poor; and here it is where the present system of dressing, brought during several centuries to great perfection, and practised in Hungary, the Erzgebirge, and Harz, with unsurpassable neatness and exactness, is applied, and becomes of so much importance.

The different modes for the winning of silver depend, to a great extent, on the substances which are combined with it, or are also contained in the ore, provided that they cannot be separated by dressing. We distinguish three processes, each one having various subdivisions, by which the silver is won or extracted:—

I. The smelting process.
II. The amalgamation.
III. The extraction by means of solutions, &c.

I. THE SMELTING PROCESS.

The treatment of silver ores by smelting is the oldest, and has been practised from times immemorial, not only in Europe, but by the Indians long before the discovery of America. It cannot be an object here to follow chronologically the improve-

ments from the infancy of metallurgy up to this day, nor can it be of any interest to dwell on the smelting of single and rare species of ores, rich in silver and simple in their composition; far more important is the treatment of comparatively poor ores, where copper, lead, etc., are combined in them, and all these metals ought to be produced at once, and with but small loss. All the smelting processes are based upon the different affinity of silver, lead, copper, and iron to sulphur, and the easiness with which silver forms an alloy with lead. In examining them, we will find it of advantage to make the following three divisions:—

A. The concentration of the silver from very poor ores in a matt, which is treated then like an ore. (Concentrating work. Raw Work.)

B. The winning of the silver by means of lead, out of galena, or mixed argentiferous lead and copper ores.

C. The winning of the silver out of argentiferous copper ores, matts, etc., by means of liquation (Seigern.)

D. The separation of lead from silver.

A. *Raw Work.*

A great part of ores are so poor in silver, and yield so little lead, that a direct treatment of them for their respective metals is not profitable. Such ores are subjected to this process, where the silver is extracted by means of pyrites, and brought into a matt, consisting of sulphides of iron, copper, lead (if it was in the ore), and silver, while the gangue and another part of iron is scorified. This operation is called the "Raw Work," and is of great importance, not so much on account of the precious metals produced by it, as by the influence of its product upon the smeltings to be described under B and C, as an almost necessary ingredient for a good result of these processes, preventing considerable losses, and making a first-rate slag. The raw work is consequently of advantage as long as the quantity of its product is in a desirable proportion to the requisites of the next process.

The charge is composed of very poor earthy silver ores (Durrerge), iron pyrites, lead slags, besides the necessary fluxes to form a slag between a singulo- and bisilicate, and ought to furnish about 50 per cent. matt, yielding not over 3 oz. silver per cwt. The quality of the applied pyrites is of some importance. It was always found, that iron pyrites, with some copper, was more powerful to bind the silver, while arsenical pyrites and zinc-blende caused some losses, and exerted a bad influence in all the following operations, especially if carried out in reverbatory furnaces. Very interesting trials respecting the action of zinc-blende in this operation have been made by Prof. Plattner, and are described in the "Hüttenzeitung," where he proves that a carefully calculated mixture of raw and calcined ores with coal dust, prevents the disagreeable consequences of the presence of blende. Still more ineffectual for the extraction of silver are

sulphates, as, for instance, heavy spar, used in the smelting works of Altai, in consequence of the scarcity of pyrites. Now, however advantageous copper pyrites may be, there is yet a limit, which ought not to be transgressed; the same power they exercise for extraction, acts in the next process to retain more silver than is allowable. Lately, successful trials have been made to replace the pyrites by matt itself, especially if the latter yielded below 2 oz. per cwt., or if the quantity of produced matt was too great. A remedy for this process is found in the lead slags, as most effectual to dissolve the gangue of the ores, rendering the smelting clean and easy, and giving the greater part of their lead in the matt. The furnaces for this operation are mostly blast furnaces, about 12 feet high, which do not differ much from the lead furnaces heretofore described. In some places, however, where fuel is cheap and the charges easily fusible, reverbatory furnaces are employed.

The matt is metallic on its fracture, dark bronze-yellow, but becomes black. The following analyses shows its composition:

	1 Lampadius.	2 Vieberg.	3 Plattner.	4 Plattner.	5 Konrad.
Sulphur,	18.75	20.80	26.487	26.702	22.489
Iron,	58.00	65.50	57.333	57.781	56.610
Lead,	12.25	3.55	8.863	4.996	5.576
Copper,	2.00	1.75	3.278	4.416	5.587
Zinc,	3.00	——	1.381	2.618	4.774
Silver,	0.14	0.13	0.151	0.086	0.200
Arsenic,	2.00	7.12	1.243	0.240	0.032
			Sb. 0.194		
	96.14	98.85	Nicc. 0.515	1.312	0.525
					Silica, 2.666
			98.440	98.151	
					98.459

Analyses of Raw Slags.

	1 Kersten.	2 Plattner.	3 Plattner.
Silica,	45.00	48.75	29.900
Alumina,	1.70	10.10	5.100
Protox. iron,	43.00	35.68	61.890
Protox. mang.,	3.80	0.02	0.703
Lime,	trace.	4.89	Sulph., 2.773
Baryta,	5.20	——	Ox. copper, 1.348
Magnesia,	trace.	trace.	Silver, 0.013
Oxide of lead, Sulph. acid,	0.70		
	99.40	99.44	101.727

The next operation with the matt is its calcining, to drive off sulphur, antimony, and arsenic, and oxidize the iron. It is done in Freiberg, in open heaps of about thirty feet length and twelve feet width, surrounded by low walls with some air-holes, the floor being covered with an appropriate quantity of wood, upon which the matt is thrown and the fuel lighted. The great mass

of sulphur in the matt, when burning, raises the heat in the heap so much as to cause a baking, which should be avoided, as it deprives a part of the mass of the action of heat and air. As soon as the greater part of the sulphur is burnt, the matt is removed, and piled up in another heap more compact than the first, to keep the heat more concentrated, and covered with small pieces, or dust. The management of the calcination is easy, but requires attention; the time used for it depends on the weather, and varies from six to twelve weeks.

Analyses of Calcined Matt.

	Lampadius.	Leschner.
Perox. / Protox. } iron,	78.01	88.86
Ox. lead,	9.123	3.31
Ox. copper,	3.180	1.56
Ox. Zinc,	2.200	2.00
Silver,	0.190	0.07
Sulphur,	0.921	0.25
Sulph. acid,	2.700	2.28
Arsen. acid,	2.720	1.25
Antim. acid,	1.460	
	100.504	99.53

B. THE WINNING OF THE SILVER FROM GALENA, AND MIXED ARGENTIFEROUS LEAD AND COPPER ORES.

I introduce this process with a few interesting remarks of the now lamented Dr. Karsten, spoken in the Royal Academy of Science at Berlin, and embraced in the last public document of this great metallurgist. He says: "History has given us no account of the name of the discoverer of the method by which to win the silver out of galena, still less of the circumstances under which a discovery was made, which has been the only source of those gigantic treasures that have overflowed for many centuries the Asiatic empires. Galena, distinguished by its specific gravity and metallic lustre, could excite, before any other ores, the supposition that a metal is secreted in it; and the winning of the metal was, in consequence of the simple composition of galena, not difficult, as soon as the attention was directed to this point. An accident, however, it must have been, that has guided probably to the separation of silver from lead, although this separation is one of the simplest metallurgical operations, and is practised substantially in the same way as it was undoubtedly done thousands of years ago. In a later period comes the application to argentiferous copper ores for the extraction of their silver, because the separation of silver from the copper in argentiferous copper ores is one of the most difficult problems of metallurgy. Here, too, we do not know how or by whom the lead was applied first, to extract the silver of this kind of ores; neither do we know of any great improvements in this department, and the practical metallurgist must confess with shame, that for three centuries hardly a

few steps were taken to replace the imperfect smelting of argentiferous copper ores by a more appropriate and perfect method. The different relations of silver, copper, and lead to sulphur, the basis of all smelting operations, have been perfectly known at least since the beginning of our century, so that expectations of radical improvements ought to be realized, if there was any possibility to do so. The greater part of silver that is won, at least in Europe, is not obtained from silver ores, but from argentiferous lead and copper ores. Rich silver ores will be mixed with lead or galena always with advantage. Poor silver or argentiferous copper ores ought to be worked, as far as present metallurgical knowledge can determine, by the extraction (III.) to avoid the lead-work, which, even in the best case, is comparatively disadvantageous, and reminds one of the infancy of metallurgy."

Thus far Mr. Karsten. In looking over our present class of ores, we meet first with the galena, which yields from a half to six ounces per cwt. The whole process, as far as it concerns the winning of argentiferous lead, is already described in this Magazine for the last month, and leaves nothing else than the separation of silver from the lead. Now, as all the smelting operations embraced within these remarks leave argentiferous lead, I thought it best to make a distinct division for the separation (see D.)

The treatment of argentiferous lead and copper ores is more complicated if mixed together in various proportions, or the smelting of the first with matt from the raw work, and when, as it is usually done in most cases, a certain class of silver ores are added. We can see at a glance, that the methods adopted for this purpose must be numerous, not only in respect to the complication of the ores, but with reference to local circumstances. It would be impossible to describe even a majority of them in a short space, but I have chosen two modes, which are practised in Freiberg and Hungary, and are the result of numberless trials. They differ not so much in the principle, as in the arrangement of the charges, and in the use of lead, lead ores, or products for the extraction.

The first of these methods consists in smelting the calcined matt (see I.) together with calcined argentiferous lead ores, accessory products from former smeltings and cupellation, a small quantity of silver ores, dross (scoriæ), and lead slags. The benefit of the addition of raw matt, of which I have already spoken, is so important, that the losses of lead without it would be considerable. The calcined raw matt not only offers to the superfluous silica its great quantity of protoxide of iron (see Analysis) for a light, fusible slag, hindering the lead from scorification, but its peroxide, reduced partly to iron, precipitates another part of metallic lead. The theory of this smelting process, the action of the substances in the furnace upon each other, is described in the last number of this Magazine, p. 45; and I do not repeat it here, but

it may be remarked, that the necessity of having the raw matt in this process, in the place of minerals, which could not be had much cheaper, if altogether, is the only cause for winning the silver out of ores which, under other circumstances would hardly pay expenses, while, at the same time, a small amount of copper can be saved. These facts show, that the proportion of the matt in the charge has to be well regulated; if not, the whole benefit of it will be lost. Long experience has proved in Freiberg, that 50 to 70 per cent. of raw matt are required. Another important point is the proportion of silver to the lead in the charge. It is known, that the property of the lead, to extract noble metals and form an alloy, has its limits, which must be considered in a process where every additional loss of metals is doubly sensible; consequently, the charge should not be richer than 1 per cent. silver for 100 of lead, and not less than one half per cent. if the silver is separated by cupellation; while, if Pattinson's method, or zinc, is applied, a small yield is not so bad a consequence.

It was mentioned above, that a certain quantity of oxidized lead products—litharge, scrapings, scoriæ, etc., was added. These substances are not mixed with the charge, but divided into as many parts as the number of times the furnace is tapped in 24 hours, and each part charged for itself after the tapping. We will see, that by this management only a small part of the charge comes in contact with the reduced lead in the tunnel, but has to penetrate it in the hearth and receiving hearth, where the silver forms an alloy. Trials to smelt uncalcined ores in Freiberg, have been unsuccessful, because they contain too much antimony and arsenic, which are removed partly by roasting. The slag must be a singulo-silicate.

The products are:—

1. Argentiferous lead.
2. Matt (sulphuret of iron, copper, lead, etc., with some silver.)
3. Lead slags (corresponds to the raw work).

I give a few accounts of the charges and products of the smelting works at Freiberg:—

	100 parts of the charge contains		Yield in 100 parts.
Calcined lead ores,	23 per cent.	Lead,	28 per cent.
" " (better),	13	Copper,	0.1
Silver ores (poor),	12	Silver,	0.17
Copper ores (poor),	0.7		
Calcined raw matt,	19.5		
" "	3.0		
Litharge,	11.7		
Black litharge,	2.7		
Hearth,	2.9		
"	1.5		
Scoria,	3.0		
Raw Slags,	5.6		
"	1.4		
	100		

	Produce (in per cent.)		
Argentiferous lead, .	26 per cent.	Taken of silver, . .	96 per cent.
Matt, ...	9	" "	3.27
Scoria and "speise," .	2.7	" " .	0.27
Slags, ...	62.3	" "	0.46
	100		100

Another account showed, that

Of 100 parts Lead.	100 parts Silver (in the charge).	
74 per cent.	843 per cent. was in the	lead.
8.1	11.6 " "	matt.
0.2	0.3 " "	"speise."
1.7	1.3 " "	salamanders, scoria.
3.7	1.5 " "	slags.
87.7	99	

The balance is lost by evaporating.

Analyses of "Lead Matt," by PLATTNER.

	1	2	3
Sulphur, . .	21.314	19.852	22.847
Lead, . . .	20.250	23.288	21.816
Iron, . . .	27.051	36.017	37.202
Copper, . .	27.614	15.277	12.944
Nickel, . .	1.010	2.329	0.544
Zinc, . .	0.231	0.186	1.489
Silver, . . .	0.117	0.121	0.099
Arsenic, . .	0.650	1.248	0.731
Antimony, . .	1.005	0.849	0.718
	99.242	99.117	98.340

Ramelsberg, in his "Metallurgy," calculated the atomical proportions as follows:—

	Lead.		Iron.		Sulph.		
1.	1	:	4.9	:	4.1	=	$Pb\,S + Fe\,S + (Fe_2\,S)^2$
2.	1	:	5.7	:	3.7	=	$Pb\,S + (Fe_2\,S)^3$
3.	1	:	5.6	:	5.2	=	$Pb^2\,S + (Fe\,S)^7 + Fe_2S)^2$

Analyses of the Metallic Mixture called "Speise," by KERSTEN.

Sulphur, ...	1.02	2.20
Arsenic, ...	20.10	18.40
Iron, ...	51.00	37.21
Nickel, }	14.90	22.72
Cobalt, }		6.14
Lead, ...	10.10	11.10
Copper, ...	1.25	1.10
Silver, ...	0.05	0.08
	98.42	98.95

Analyses of Slags of this Smelting.

(See Rammelsberg's "Metallurgy.")

	Erdman.	Kersten.	Amburger.
Silica,	37.300	30.50	43.26
Alumina,	8.150	5.10	.....
Protox. iron,	40.923	55.74	46.95
Lime,	2.644	.....	.....
Baryta,	.....	.....	.....
Magnesia,	3.000	.....	0.45
Ox. lead,	7.168	4.00	2.00
Ox. zinc,	.....	0.85	1.91
Ox. copper,	.....	MnO. 2.20	0.25
			5.62 Perox. iron.
	99.205	98.39	101.70

Analyses of Salamanders.

(See Kerl, Huttenprocesse.)

	Rienecker.
Silica,	42.00
Protox. iron,	40.53
Ox. lead,	13.78
Lime,	3.54
	99.85

	Strohmeyer.	Genth.
Carbon,	0.38	1.12
Sulph.,	2.06	0.31
Phosph.,	1.25	0.04
Arsenic,	1.40	....
Silica,	0.35	1.28
Molybdeen,	9.97	6.98
Iron,	76.77	84.24
Nickel,	1.15	....
Cobalt,	3.25	2.85
Copper,	3.40	4.52
Manganese,	0.02	....
	100	100.78

The next treatment of the produced matt—the so-called "lead matt work"—consists in a series of successive calcinations and smeltings in low blast furnaces. The object is, to extract about two thirds to three fourths of its silver, by its own lead, and by extra additions of lead products, and to concentrate the amount of copper, until a matt is produced, which can be worked for argentiferous pig copper, from which the rest of silver is extracted by liquation (Seigerung). The fluxes for this process accordingly consist in copper slags, quartzose copper pyrites, scoria, besides lead products, and the slag ought to be "fresh," i. e. a singulo-silicate. After from four to six smeltings, the produced matt has about the following composition, and is delivered to the copper works:—

	Thle.	Kersten.	Kersten.
Sulphur,	21.00	11.2	9.1
Lead,	24.80	9.8	7.1
Iron,	15.20	44.0	40.1
Copper,	36.20	27.8	33.2
Nickel, Zinc,	2.64	4.4	8.2
Silver,	0.16	1.7	1.1
Arsenic,	.....	1.1	1.1

Every one of the smeltings furnishes argentiferous lead, besides the matt; it is, however, impure. A few analyses will show the quality of lead of the successive operations :—

(Kerl, Huttenprocesse.)

	Lead.	Copper.	Antimony.	Silver.
First smelting,	94.74	0.88	4.17	0.22
Second "	95.65	0.91	4.17	0.19
Third "	98.49	0.76	0.60	0.16
Fourth "	99.00	0.60	Iron, 0.28	0.12

Analysed by Jordan.

I leave the Freiberg operations here, and pass over to the method adopted in Hungary, which is of great interest on account of the variety of ores in this mining district, rendering their treatment difficult.

The ores consist of auriferous and argentiferous pyrites, and its copper ores, together with various silver and lead ores. The object is to win the gold, silver, copper, and lead by one series of operations, they being connected with each other. For this purpose, the processes are divided into three departments, of which each one works a separate class of ores or products upon the same principles :—

1. Smelting of ores rich in silver, but poor in copper.
2. Smelting of poor ores.
3. Smelting of argentiferous matts.

(The amount of gold makes no difference in the classification.)

The lead used for extracting the precious metals is applied

(1) As calcined ore, litharge, or other lead products, with the first class minerals, or with copper matts, to desilverize them in *one* smelting.

(2) As metal, in the receiving hearths, where the molten charge passes through and enriches the lead with its silver, for the second class of minerals.

The general produce will be :—

(1) Auriferous and argentiferous lead, rich enough for cupelling.
(2) Copper matt, desilverized so far as to be worked directly for copper.

The difference between the smelting in Freiberg and this, is the application of lead in the receiving hearth, and the production of a copper matt, which has not generally to be subjected to the liquation (Seigerung).

We consider, first: *The smelting of poor ores.* They are smelted in high-blast furnaces of 18 to 20 feet in height, 50 inches wide on the tuyere wall, 34 inches on the breast wall, 36 inches in depth, with two blow-pipes of respectively 22 and 26 inches elevation from the receiving hearth, and 1 to 2 degrees inclination; or, in half high-blast furnaces, of 12 feet in height, 42 inches wide on the tuyere wall, 30 inches on the breast wall, 34 inches in depth, with one blow-pipe of 20 inches elevation and 2

degrees inclination. The sole, of fire-proof cement (Gestübbe), begins a few inches below the tuyere, and is inclined 18 inches down to the receiving room, which forms a canal, and is connected with the tapping-pit. The working *personnel* consists, for a high furnace, of two smelters, six assistants and eight workmen, for 24 hours, 16 men, with a production of 2⅘ tons; a half-high furnace takes two smelters, four assistants, and eight workmen, together, 14 men, in 24 hours, producing 1⅗ tons; two furnaces keep a blacksmith employed in repairing tools. The charge is composed of all the poor auriferous and argentiferous ores, with less than 2 ounces silver in 100 pounds, and poor lead products. Slags are applied only so far as necessary, to keep the nose of the furnace in order, as they cause a considerable loss of gold, and some 10 to 12 per cent. lime acts as flux. The ores are taken about 16 to 20 per cent. raw, and 80 to 84 per cent. calcined, and composed with due regard to the stores on hand—sometimes a matter of great difficulty. The lead for extracting is put in the receiving hearth, in the approximate proportion of 200 parts to one of auriferous silver in the charge.

The products are,—

Argentiferous lead, (for cupelling).
Matt, (waste, scoria).
Poor slags, (thrown away).

The matt is, in consequence of the various ores, very different in its fineness (yield in gold and silver), and cannot be worked always the same way. If rich, it is added to the charge of rich ores (No. 1); if poor, it passes through the same operation again; if neither, it is worked by itself. This last operation is called the "poor lead work," "matt smelting." At last, the matt may be unusually rich in copper, in which case it is delivered to the copperworks.

We pass to the smelting of *rich ores.*

The object is as before: to combine the greatest part of the precious metals with lead, and concentrate the rest in a small portion of matt. The construction of the furnaces and the labor is about the same as in the last process. The composition of the charges depends, besides the amount of gold and silver in the ores, on the quantity of lead substances which can be procured, and the richer the ores, so more of those substances has to be added. The usual charge consists of: argentiferous ores, 55–60 per cent., calcined matt, 15–30 per cent., and lead substances (oxidized) 40–80 per cent.; besides the usual fluxes, some granulated pig-iron is added, which increases the fineness of the lead.

Products:—

Argentiferous lead (for cupellation).
Moderately poor matt (goes to a further working).
Poor slags (scrapings, &c.).

The principal difference between this and the last operation

is, consequently, that here the lead is reduced, and extracts the noble metals in the tunnel of the furnace, and at the moment of its melting, while, in the other case, the metallic lead is put in the receiving hearth, and the charge itself is strictly composed not to reduce any lead.

The third part of the general operations is the smelting of the matts produced by the two last smelting processes. Although the matts of each kind of smelting are treated by themselves, the principle is the same, and the treatment analogous to the respective operations where they originated. The matt is calcined, and smelted in half-high furnaces, which are similar to those already described, with the exception that the tuyere has only 16 inches elevation, and is more inclined.

The composition of the charges of course varies; generally 15–20 per cent. litharge and 40–50 per cent. slags are added for poor mats; and 30–50 per cent. lead products, and 20–30 per cent. slags for rich matts; besides this, some lead is applied in the receiving-hearths for the first-named class of matts. Products of this process are:—

Argentiferous lead, (for cupellation).
Matt, (goes to the next process).
Slags, (dross, salamanders, &c.)

It was mentioned above, that even in the first smelting, occasionally a matt is produced which is rich in copper. These matts, together with those of the last operations, yielding, at an average of 8–20 pr. ct. copper, some silver and gold, besides lead, are subjected to one or two final smeltings, after which the copper matt then produced goes directly to the copper works, and, consequently, beyond the scope of our present examinations. The matts are calcined and smelted through, with substances containing lead (of which a great portion is required), copper slags, and fluxes, in half-high furnaces, the blow-pipe having 12 inches elevation. (It will be seen that the more the smelting approaches to the copper processes, so much more it requires heat, and, therefore, less elevation of the blow-pipe).

The products are the same as before: the lead goes to the cupelling; the matt, yielding now 30–35 per cent. copper, to the copper works; and the slags are, if poor, thrown away.

The following are a few results of the different processes described:—

1. *Smelting Poor Ores.*

		Silver,	Gold, per ton (charge.)
(a.)	Yield of	7.5 oz.	0.48 oz. per ton.
	Yield of the produced lead	60.0 "	4.50 " "
	" " " Matt	22.0 "	1.00 " "
(b.)	Of	199.055 lbs.	11.062 lbs.
	was brought out	168.840 "	10.877 "
	Loss,	30.215 "	0.185 "
	or, Silver	15.16 per cent.	Gold, 1.7 per cent.

		Silver,		Gold,	
(c.)	Of the produced	Silver,		Gold,	was
	In the lead,	0.405 lbs.	.	0.565 lbs.	
	" matt,	0.500 "	.	0.430 "	
	Scrapings, dross, &c.,	0.095 "	.	0.004 "	
		1.000 "	.	1.000 "	

(d.) The proportion of the products was :—

Lead,	22.5 per cent.
Matt,	62.0 "
Waste, dross, &c.,	15.5 "

(e.) Proportion of silver to lead in the charge :—

1 : 238.

(f.) Consumption of coal :—

740 lbs. per ton (charge).

2. *Smelting Rich Ores.*

		Silver,		Gold,	per ton (charge.)
(a.)	Yield of	111.0 oz.	.	0.73 oz.	
	yield of produced lead	189.2 "	.	5.84 "	per ton.
	" " " matt	57.2 "	.	poor "	"

(b.)	of	1071.08 lbs.	.	21.40 lbs.	
	was brought out	1037.69 "	.	23,63 "	
	Loss,	33.39 "	.	2.23 "	surplus.
	or	3.1 per cent.		10.2 per cent.	

(c.)	Of the produced,	Silver,		Gold,	was
	in the lead,	78.00 per cent.	.	98.00 per cent.	
	" matt,	14.70 "	.	1.00 "	
	waste, dross, &c.,	7.30 "	.	1.00 "	
		100.00 "	.	100.00 "	

(d.) The proportion of the products was :—

Lead,	50.8 per cent.
Matt,	30.6 "
Waste, dross, &c.,	7.30 "

(e.) Proportion of silver to lead in the charge :—

1 : 191.

(f.) Consumption of coals :—

388 lbs. per ton (charge).

3. *Smelting of Poor Matt.*

		Silver,		Gold,	per ton (charge).
(a.)	Yield of	28.09 oz.	.	0.64 oz.	
	yield of produced lead	139.8 "	.	3.84 "	per ton.
	" " " matt (no account kept).				

(b.)	of	63.14 lbs.	.	1.65 lbs.	
	was brought out	66.81 "	.	1.93 "	
	Surplus,	3.67 "	.	0.28 "	
	or,	5.8 per cent.		17.4 per cent.	

(c.)	Of the produced,	Silver,	Gold, was
	in the lead, . . .	75 per cent. .	80 per cent.
	waste, dross, &c. .	22 " .	15 "
	in the matt, . . .	the rest.	

(d.) Proportion of the silver to the lead in the charge:—
1 : 180.

(e.) Consumption of coals:—
776 lbs. per ton (charge).

4. *Smelting of Rich Matt.*

(a.)	Yield of	Silver,	Gold, per ton (charge).
		32.0 oz. .	1.2 oz.
	yield of produced lead,	88.9 " .	0.9 " per ton.
	" " " matt,	27.5 " .	unknown "

(b.)	of	284.32 lbs. .	1.61 lbs. in the charge,
	was brought out .	303.32 " .	2.42 "
	Surplus, . . .	19.00 " .	0.81 "
	or, ...	6.7 per cent.	50 per cent.

(c.)	Of the produced,	Silver,	Gold, was
	in the lead, . . .	80 per cent. .	98 per cent.
	waste, dross, &c., matt,	20 " .	2 "

(d.) Proportion between the silver and lead in the charge:—
1 : 380.

(e.) Consumption of Coals:—
732 lbs. per ton (charge).

5. *Smelting of Argentiferous Copper Matts of the four last operations.*

(a.)	Yield of	Silver,	Gold, per ton (charge).
		89.0 oz. .	2.24 oz.

		Copper.	Silver.	Gold.
(b.)	of	161.45 cwt. .	165.78 lbs. .	2.28 lbs.
	was brought out	158.21 " .	164.32 " .	2.38 "
	Loss, . .	2.00 per cent.	0.88 per cent.	surplus.

(c.) The produced matt yielded,—

Copper, ...	38 per cent.
Lead, ...	10 "
Auriferous Silver, ...	$1\frac{5}{8}$ "

After a second smelting, the matt yielded,—

Copper, ...	49 per cent.
Lead, ...	3 "
Silver, ...	$\frac{3}{4}$ oz. per cwt.

sent to the copper works.

Note.—The surplus in the above accounts originates from imperfect assaying of the various ores and additions to the charges, and the impossibility of finding an exact average sample of every heap.

C. THE WINNING OF THE SILVER FROM ARGENTIFEROUS MATTS, BY LIQUATION (SEIGERUNG).

In entering upon this department we exclude all argentiferous pure copper ores, or mixtures of copper and lead ores, as the first will be treated better by extraction (III.), and the latter was described just above; and we limit our examinations to the argentiferous matts, which are, in some mining districts, subjected to this process.

The liquation (Seigerung, ressuage), is an operation which is founded on the fact that when argentiferous copper and lead, in a fixed proportion, are melted together, and exposed afterwards to a certain degree of heat,—avoiding the oxidizing of the metals, —an alloy of 1 aeq. copper and 12 aeq. lead, binding the silver, is sweating out, and leaves behind another alloy of 12 aeq. copper and 1 aeq. lead, more or less desilverized. This method, which includes about seven principal operations, is decidedly imperfect, because the resulting copper and lead are both more or less impure, and tedious as the numerous operations are, they delay a clear settlement of accounts for a long time.

We follow the successive operations, as they are described by Professor Kerl in his work "Harzerhutten Processe:"—

1. The matt, being well calcined, is melted, together with raw slags, in a low-blast furnace, and this operation is repeated several times. The last products are argentiferous pig-copper, besides some matt which is saved for another time.

2. The pig-copper is mixed with lead in the proportion of 100 : (200–270), and passes a low-blast furnace of somewhat singular construction. The products are: "liquation cakes," (Frischstücke, pieces de liquation).

3. The cakes are exposed on the liquation hearth to an appropriate heat, where the lead, extracting the most of silver, sweats out, and leaves an alloy of copper with lead, called "carcasses," (Kichnstocke, gâteau de ressuage).

4. The carcasses undergo a roast-smelting, in a hearth furnace with blast, to oxidize and scorify by the blast all the strange metals, lead, &c., in the copper.

5. The produced copper is refined and sold.

6. The waste, dross of the last smeltings, is mixed with rich copper slags, and worked in a low-blast furnace. The products are: lead (goes to the cupellation), liquation cakes, and rich slags.

7. Rich slags from all the preceding operations are smelted by themselves, and furnish lead, carcasses, waste, and slags.

The smelting works at Altenau, on the Hartz, treated, 1846, 81,100 lbs. matt, yielding 61 lbs. 7 oz. silver, 32,174 lbs. copper, 14,416 lbs. lead, and produced 54 lbs. 10¼ oz. silver, 21,400 lbs. copper, and 12,400 lbs. lead, besides a great quantity of accessory products.

D. THE SEPARATION OF THE SILVER FROM THE LEAD.

The previous operations have shown us how the silver was bound to and united with the lead; now we proceed to inquire how these two metals are separated from each other. There are three methods, following a different course, and coming to the same end: the cupellation, Pattinson's method, and the separation by zinc.

(*a*) *The Cupellation* (*Clearing, Abtreiben*).—Auriferous or argentiferous lead, subjected to an oxidizing smelting, forms oxide, which goes to the periphery of the convex surface of the metallic bath, exposing a new portion of the metal to the action of the air. If the molten oxide is constantly removed, it leaves at last nothing but the precious metals. The furnaces are constructed on the usual principles of reverbatory furnaces; but they have two blow-pipes, and use blast for oxidizing the lead more quickly. The hearth is round and concave, and must be made of substances which do not exert a reducing action on the oxide, but suck it off without being chemically united, and which stand the heat without cracking. As appropriate for this purpose, bone ash was taken in old times; subsequently, the smelters took marl, which is pounded, sifted, moistened, and afterwards stamped on the hearth. Besides, the furnace has, opposite the fire-bridge, an opening, which serves as a flue and for charging; another hole is almost opposite the blow-pipes, and near the fire-bridge, for removing the litharge. The tap over the hearth is made of iron, and movable. The hole for removing the litharge is filled up to the level of the molten lead with marl; and, in the course of the operation, scratched down in the same degree as the metal is sinking. The manipulations are the following:—

1. *The charging.*—The furnace, being cleaned on the hearth, is charged with the metal, either at once or in successive parts. The charge being on the hearth, the tap is moved in its place, luted, and the furnace lighted.

2. *The first fire* will melt the charge slowly, while a part of less fusible impurities will form a crust, and are skimmed.

3. *The second fire* increases the heat, the blast begins to operate, and the skimming is continued until the fluid crust of black litharge has changed its color from black to gray, green, dark and light red-brown to light yellow-brown, and the mass has lost its toughness. At this point, the fire and blast are moderated, and the

4. *Litharge work* is begun. In the first period, the fire is comparatively stronger, and the blast ought to work in two opposite directions; afterwards, the fire is moderated, and the blast works crossways, until, towards the end of the operation, the heat is increased to get a pure lightening of the silver. During all this time the attention of the refiner is directed to the management of

the drain for removing the litharge—a manipulation which requires much experience.

5. *The lightening.*—The point where the silver comes, when the molten litharge, diminishing by degrees, and running apparently as round spots over the silver, suddenly disappears, and presents to the eyes the brilliant surface of the silver.

After the lightening, the lid of the furnace is removed, and the silver broken out. The products of this operation are:—

Lightened silver, to be refined.
Litharge, reduced to lead or sold.
Skimmings, comes to the charge for raw smelting.
Hearth, charged with lead ores.
Smoke, " "

The loss of silver varies from 0.46 to 0.75 per cent. The smelting works at Altenau on the Harz produced, 1844–45:—

Of 784 tons, 1,800 lbs. argentiferous lead.
2,061 lbs. 15 oz. silver.
1,046 cwt. litharge, 2d quality.
12,810 cwt. litharge, 1st quality.
2,776 cwt. hearth.
941 cwt. skimmings.

The smelting work, Lautenthal, on the Harz:—

Of 1,601½ tons argentiferous lead.
4,530 lbs. 5¼ oz. silver.
1,180 cwt. litharge, 2d quality.
22,580 cwt. litharge, 1st quality.
6,290 cwt. hearth.
880 cwt. black } skimmings.
1,495 cwt. yellow } skimmings.

The smelting work, Kapnick, Hungary, in one operation:—

Of 1,296 cwt. argentiferous lead.
426 lbs. silver.
11.18 lbs. gold.
705 cwt. lead from reduced litharge.
204 cwt. litharge, 1st quality.
400 cwt. litharge, 2d quality, and skimmings.
825 cwt. hearth.

The smelting work, Fernezely, Hungary, in one operation:—

Of 2,891 cwt. argentiferous lead.
22.67 lbs. gold.
1,086 lbs. silver.
1,064 cwt. litharge, 1st quality.
68 cwt. litharge, 2d quality, and skimmings.
258 cwt. hearth.

Analyses of Skimmings and Smoke.

	Poullaouen.	Skimmings of Freiberg.	Smoke of Freiberg.	
Oxide of lead,	85.1	95.5	48.3	
" antimony,	4.8	....	3.9	
" copper,	4.9	0.5	....	
Protoxide of iron,	5.4	0.8	....	
Oxide of Zinc,	5.0	1.1	25.7	
Arsenic acid,	....	2.8	14.4	
Sulphur,	6.8	....	5.5	ox. of cobalt.
Silica,	5.8	....	....	ox. of bismuth.
Alumina,	0.3	....	0.5	
Lime,	0.7	....	....	
Lead,	32.0	....	....	
	101.0	99.7	97.2	

(*b*) *Pattinson's Method.*—In the year 1833, Mr. Pattinson took a patent for a new method to concentrate the silver in the lead. The process is founded on the fact, that, if a pure alloy of silver and lead is molten and stirred constantly until it arrives at a certain temperature, crystals of poor metallic lead will fall to the bottom, leaving the rest richer in silver. This operation is repeated several times, until the silver is concentrated in one part, while the other part of lead is more or less desilverized. We pass over this process, as it is already described in this Magazine (Vol. III. p. 86), remarking, that its application is only profitable for *poor* and *pure* alloys, as extensive trials have shown on the Harz.

(*c*) *Desilverizing of Argentiferous Lead by Zinc.*—Of decidedly more importance than the last concentration, is the discovery of Mr. Karsten, to separate the silver from lead by zinc, because the separation is complete, and done in one operation, while Pattinson's method does not avoid a cupelling of the enriched lead. It appears that fifteen years ago, Mr. Karsten observed, that argentiferous lead alloyed with zinc, gives its silver to the latter. He communicated these facts in his Archiv. (Vol. XVI.), but for some reasons discontinued further trials, until, in the year 1851, he heard that his invention was applied in some smelting works in Wales, by a Mr. Parkes, when he took up the matter again, and found that the results fully confirmed the practicability of the new mode of treatment. As simple as the whole operation appears on the first glance, yet there were some difficulties to overcome, and, besides the main question, it had to be determined whether the zinc itself could be separated entirely, or at least so far from the lead as not to render the latter unfit for many purposes. I cannot undertake to describe here the most systematically conducted experiments carried out on a large scale, at the request of Mr. Karsten, and with permission of the Prussian ministry, by Mr. Lange, Director of the Royal Smelting Works at

Tarnowitz; and it may be sufficient to give the final results of those experiments.*

1. The molten alloy of zinc and lead was cooled so far as to congeal the zinc, after which the lead was drawn out; on the next trial, the whole mass was congealed, and afterwards heated so as to melt the *lead* alone, and draw it. Both were imperfect in the separation.

2. The smelting vessel was provided with a slit, filled up during the melting with cement, which was scratched down at the proper time to draw the *zinc*. The result was better, but not as perfect as desirable. As soon as the zinc was nearly gone, the lead began to come on the surface of the more tough alloy of zinc and silver, and flowed down.

3. The lead below the zinc was drawn by a hole in the bottom of the pot so far as to leave some of it with the zinc behind; a new portion of argentiferous lead was added, and the operation repeated six times, at the end of which a small portion of lead remained with the zinc. This way proved to be better, but it was found, that a repeated smelting took $5\frac{2}{3}$ per cent. zinc instead of $1\frac{1}{2}$ per cent.—enough for a single operation.

4. The stirring was found to be a great disadvantage, because the oxides raised by it hindered the close contact of the metals, and formed, together with the coals, a scum, which inclosed many specks of zinc.

5. The desilverized lead was holding back, as a constant amount, $\frac{3}{4}$ per cent. zinc; near the level of the zinc, the lead yielded $2\frac{1}{2}$ per cent.

6. The smelting-pot was altered into a more cylindric vessel, of great height and small diameter, filled with zinc, and the lead added to it by a sieve in drops, avoiding all stirring. The latter was drawn, and the operation repeated (3). The result was very satisfactory, the lead being as pure as desirable, and perfectly desilverized. The zinc yielded 25 per cent. silver.

7. The following distillation of the alloy of zinc and silver was executed in a Silesian zinc-muffle, and presented no essential difficulties. The resulting silver had to be refined.

An apparatus of excellent construction was recently described by Mr. Kast in Hartmann's "Hüttenzeitung," which avoids all the disadvantages of this mode, gives very good results, and allows a continual operation. It is founded on hydrostatic principles, and consists of two communicating cylinders, the height of which are in reverse proportion to the specific gravity of the zinc and lead which they contain. Above the cylinders is the smelting-pot for the lead, from which it drops down, through a sieve in the cylinders, they being filled to a certain height with lead, and the remainder with zinc. In proportion now, as the lead drops down

* Described fully in Karsten's Archiv.

and falls to the bottom, the cylinder is filled up; when at the proper height, the zinc forces the desilverized lead to overflow into the lower cylinder, and it falls in a pot, out of which it is ladled. The zinc is drawn by an opening in the level of the separation line of the metals.

So much respecting the modes of smelting argentiferous ores and metallurgical products. Although the amalgamation method predominates in the United States and South America, it is certain, that with the progressive exploration of the mineral wealth, ores will be won which can *not* be treated by amalgamation (II.), or by the newly-discovered extraction (III.), but will require to be *smelted.* It will be seen by the previous remarks, how much metallurgical skill these operations require, and a clear presentation of the principles of the smelting manipulations carried out during many centuries in Europe, will undoubtedly contribute to promote mining and metallurgy in this country.

TREATISES UPON SILVER SMELTING.—*Karsten*, Metallurgy.—*Lampadius*, Hüttenkunde.—*Karsten's* Archiv. etc.—*Villefosse*, Richesse minerale.—*Winkler*, Freiberger Hüttenprocesse.—*Gruner*, Schmelzprocesse in Ungarn.—*Russeger*, Reisen.—*Kerl*, Harzes Hüttenprocesse.—*Rammelsberg*, Metallurgy.—*Dingler*, Polytech. Journal.—*Hartmann*, Hüttenzeitung.—*Erdmann*, Journal for Pract. Chemie, Journal des Mines, etc. etc.

Note.—In our last article entitled, "Remarks on the Process for Smelting Lead," are two or three typographical errors, which we think best to correct. On p. 41, Vol. IV., I+XI. should be placed in the column having the word *basis* at the top. On p. 43, Zn should be placed at the head of the fourth column, and Sb in the place of Zn, and S in the place of Sb. On p. 44, lines 19 and 20 from the top, read *inches* for "feet;" and in line 14 from the bottom, read 16 *inches* instead of "16 feet."

(To be continued.)

COMMERCIAL ASPECT OF THE MINING INTEREST.

NEW YORK, *March* 5, 1855.

The market for mining stocks seems only active for coal stocks, which are the only speculative ones. The scarcity of money is no longer a cause for this general inaction, which is attributable solely to the total discredit into which mining companies have fallen. Most mining stocks are held by unwilling parties, who are unable to extricate themselves from loss. The glaring mismanagement which has characterized most of the mining companies, has involved the whole in general discredit, from which time alone can relieve them. This is the precise state of things which we have all along foretold, if speculation was allowed to triumph over legitimate mining.

There is no disposition to speculate, either in stocks, or in opening new mines, or even in following up with vigor the development of old ones, only partially and ineffectually worked. Most of the companies, also, have con-

tracted heavy debts on very usurious terms. The Mining Stock Board has suspended its sessions from lack of all business. The mining property of the country is, however, too great and too valuable to be wholly neglected, even now, or not to become again the subject of active interest.

The *Fulton Copper Company* of Lake Superior, has been reorganized under the general law of the State of Michigan; and its former 100,000 shares have been commuted into 20,000 shares, new, at $25 par value; and an assessment made on the 20,000 shares, of $1 per share, in order to resume active work on the opening of the season at the mine. The old stockholders cannot obtain their new shares unless they pay the assessment; and their refusing to do so excludes them from all benefit. The old stock was not assessable. The new is so from time to time; so that the reorganization has been remedied of the difficulty which previously existed of obtaining funds. The privilege of non-assessable stock may therefore be regarded as being very uncertain. There is always a way of dodging. The new President of the Company is William J. Ladd, of New York, the largest stockholder, owning we believe 15,000 shares. The other directors are B. S. Hart, Alfred Douglas, Joseph Kershaw, William D. Kennedy, all of New York, Simon Mandlebaum of Detroit, Michigan, and Stephen Ball of Boston.

The assessment of $1 per share is payable on the 15th March, at the Company's office, 18 William street, New York.

There has been also a re-charter of the *McCulloch Gold and Copper Company*, from the State in which the mines are situated, and we learn that the Company is pursuing its mining operations with renewed vigor. The debt which it had contracted has been got rid of. The stock is again in the market, and has been sold, at four or five shillings per share, having an upward tendency.

The coal stocks which are active, are the *Reading* and the *Cumberland*. The *Delaware and Hudson Canal*, and the *Pennsylvania Coal* are rising stocks, but without speculative activity, of which there is, however, little to be obtained, while there is a limited and steady inquiry. Established on a sure basis, without having artificial values, forced by mere speculation, they do not fluctuate, and only decline in very stringent money times, such as we saw last year, and are not likely to see again for some time.

The prospects of the money market are good, and as the abundance of money increases, and the difficulty augments of investing it satisfactorily, while the value is declining, there is some reason to expect that the want of confidence which at present exists may be overcome, so as to re-excite a very active speculation.

The two speculative coal stocks have at present an upward tendency.

There has been most activity and advance in *Reading*, but *Cumberland* is steady at a sensible appreciation, from the new and valuable discovery on its estate of large beds of iron ore, of the kind called Black Band, easily worked at a small cost, and converted into pig iron, which may add ultimately to the value of the Company's property. Some time however will be required for its development. The necessary steam engines can be put up at small expense. The directors, however, wish rather to leave the iron mines, and most probably a

new company will spring up to work them. The working of the iron will add to the consumption of the coal on the spot, especially of the very small coal hitherto considered as waste. The discovery can hardly fail to be a profitable one. Some few changes have been made in the directors of the Company. Messrs. Holbrook, Loomis, and others have resigned, and the vacancies filled by the election of Judge Sherman, Mr. Vassar of Poughkeepsie, and Mr. Case. At the Stock Exchange, this stock as well as Reading is the subject of contest between the Bulls and Bears. The leading Bear on the market, Mr. Jacob Little, with his friends, have been some time actively engaged in operating in both the stocks for a decline. The result has been a rise.

The *Reading Coal Company* is the most prosperous of any. It has largely diminished its floating debt. It has made great profits during the last year. It has carried coal to the full extent of its capacity, at increased freights, and higher coal prices. New roads are springing up to connect with it, which will multiply its business and require additional tracks.

The gross receipts in 1854, were $3,781,639 91; and the net $2,010,438 21, being an increase of $651,662 87 on the year preceding. The dividend fund proved to be $723,340 54; from which has been paid a dividend of 10 per cent. to the holders of common stock, and three per cent. additional to the holders of the preferred seven per cent. stock, which is a regular charge. The cash earnings have been absorbed by the floating debt and the dividends paid on stock.

The floating debt is thus reduced from $1,200,000 to $500,000, which will soon be discharged. The finances of the Company are in a very improved state, and give much confidence to speculators. The rise in the stock has been steadily progressive since the publication of the last report of the Company.

The *New American Coal Company*, the stock of which has not yet been placed on the board, is under the auspices of Moses Bramhall, Esq., of Jersey City, and State Senator, the President of the Company.

The Company have taken offices in the Commonwealth Bank Buildings, corner of Nassau and Pine streets, and are vigorously working their mines. They have made a contract with the Baltimore and Ohio Railroad Company for the transportation of 30,000 tons of coal for this year.

The *Hampshire Coal and Iron Company* have made a similar engagement, but for a larger quantity. The stock of this Company will shortly be on the board. The whole capital of $2,000,000 has been subscribed for, and the Company have ample funds to pay its way, and pay off all its debts. It is now doing a satisfactory business.

The office of the *New Creek Coal Company* has been removed to Philadelphia, and Cephas G. Childs has been elected President, with Alfred Ashfield, Charles Miller, James Dundas, and Robert Lyon as Directors. The stock is unsalable in this market.

All the Lead and Zinc Companies appear under a cloud. The *New Jersey Zinc* and *Pennsylvania Zinc Companies* are much depressed. They pay no dividends, and from this fact it seems as if their expenses absorbed all, perhaps more, than their earnings. The management of the first-named Com-

pany, judging from their statements and promises, none of which have been realized, has been bad.

Gardner's Gold Mining Company is one of the few mining companies that has lived through the storm that has crushed so many. With an ample working capital, it has continued with full and unabated force the opening of the mines. A large machine at present crushes 200 tons of ore daily, from which the Company is in steady receipt of funds, and another and larger one is in preparation, capable, it is said, of crushing 200 to 300 tons daily, yielding rich returns to the Company. This Company has steadily pursued its object. The stock has not been offered on the market since the great depression of the mining interest.

The Gardner's Crushing Machine Company has been dissolved, and reorganized under the name of the Gold Quartz Mining Company, and its machines are in use in California.

Among the great dearth of dividends from mining adventures, we are glad to record the announcement of one from the prosperous Minnesota Company, which has declared a dividend of 30 per cent., or $30 per share, out of the net earnings of 1854, and payable one half the 16th April, and the remainder the 16th July.

We have heretofore alluded to the foreign demand which has sprung up for our native copper. The *Minnesota Company* is benefiting largely from the demand. Messrs. Rothschilds & Co. are large buyers of their ore for the French market. They sold 150,000 pounds last year, and have new orders for 200,000 pounds during this year. Their copper ore is nearly pure, yet contains a portion of silver which is of much value. The separation is effected at Paris.

The *Dora Coal Company*, of Augusta County, Virginia, has been reorganized, and now appears with a New York charter, under the title of the New York and Virginia Coal and Iron Company. The coal is anthracite, and is well adapted for the manufacture of iron from the ores in the vicinity, under the same ownership. H. P. Russ is the President, the same who constructed the Russ pavement.

The *Breckenridge Coal Company* are the owners of coal mines of a peculiar bituminous quality in Kentucky, within 18 miles of Cloverport, on the Ohio River, to which the coal is transported by the Company's railroad, and where it is delivered and sold at 5 to 6 dollars per ton. The capital consists of $3,400,000, contingent stock, $600,000, of 8 per cent. preferred stock, of which latter only $38,000 has been sold, the remaining $562,000 being still held by the Company, but which it offers to sell at the par value of $100 per share.

The slate quarries of Vermont have been bought, and the owners have formed a Company, under the title of West Castleton Railroad and Slate Company, of Rutland County, Vermont. The railroad connects the mines with the Whitehall and Rutland Railroad. The Company is a manufacturing as well as a mining one. The President is N. Sturtevant, Esq. The New York office is 90 Broadway. The Company make monumental slabs, fences for churchyards, posts, gravestones, mantels, sinks, wash-tubs, billiard beds, black-

boards, table tops, registers, stones, hearths, flagging of all kinds, roofing slates, and tomb tops, &c., &c.

In the Boston market there is considerable improvement. An assessment of $2 per share has been made on the *Toltec Mining Company*, of Lake Superior, payable on the 5th March, since when the stock, strange to say, has advanced a dollar per share above the assessment. Sales have been made at Boston at 9½, and 10 has since been asked.

The stock of the "National" has also advanced to 13½. In consequence of the property in dispute between the Minnesota Mining Company and the National being decreed to the latter Company, this stock has advanced from 8 dollars up to 13½, at which sales have been made at Boston. During the pendency of the suit the stock fell from 30 to 8, so that the reaction is not yet equal to the previous decline.

The stock of the Minnesota Company since the declaration of the dividend has advanced from 150 to 175 offered.

The *Cliff Mine* is stated to be raising over 100 tons copper per month, and the Minnesota in December yielded 77 tons. The Isle Royale only yields 24 tons per month, and the Albion 12 tons.

The Copper Falls yielded 18 tons per month, per 24 head stamps, besides mass and barrel work. The Norwich had 80 tons out on the 1st January, and expected to get 30 more in all that month.

The prospect of the mines at Lake Superior in the approaching season is very good.

Many improvements sanctioned by Congress and guaranteed by Congressional appropriations are being made in the mining districts; such as the Saut Marie Canal, to be finished in the spring on the opening of navigation; the deepening of the St. Marie River, and the deepening of the channel across the St. Clair flats. The increased facilities, the reduction of wages, which alone is a very important consideration, and the multiplication of steamboats, insure not only a greater production, but a freer transportation to market.

The mining stocks of most prominence, and likely to become active on the market, are the following:—Cliff, Minnesota, Toltec, North West, North Western, Copper Falls, Isle Royale, Portage, Rockland, Windsor, National and Norwich.

JOURNAL OF GOLD MINING OPERATIONS.

U. S. MINT OPERATIONS FOR 1854.

PHILADELPHIA.

Gold Deposits	$36,269,388 06
Gold Coin struck	20,049,799 00
Fine gold bars	17,643,270 58
Silver deposits, including purchases	4,480,741 14
Silver coinage executed	5,373,270 00
Copper coinage	42,638 35
Total deposits in gold and silver	$40,750,129 82
Coinage, including fine gold bars	43,108,977 92

This coinage is comprised in 33,919,921 pieces.

NEW ORLEANS.

Gold deposits	$1,239,135 48
Silver deposits	1,311,703 03
Gold coinage	1,274,500 00
Silver coinage	3,246,000 00
Total deposits of gold and silver	$2,450,838 99
Total coinage of gold and silver	4,520,500 00

This coinage is comprised in 10,332,750 pieces. The coinage exceeds deposits, owing to the amount of bullion remaining over from deposits of the previous year.

DAHLONEGA.

Gold deposits, (including silver coin	$1,706,61)	$281,932 06
Total coinage		292,760 00

Comprised in 62,228 pieces.

CHARLOTTE.

Gold deposits	$213,606 21
Cold coinage	214,052 50

Comprised in 46,578 pieces.

SAN FRANCISCO.

Deposits since 3d April last	$10,404,560 09
Coinage do	4,084,207 00
Manufacture of fine bars, valued at	5,863 16
Unparted bars, prepared, assayed and stamped	5,641,504 05
Total	$9,731,574 21

NEW YORK (SINCE 10TH OCTOBER LAST.)

Desposits to January 1, 1855, of which $76,307 is in silver	$9,333,200 00
Fine bars, prepared, assayed and stamped	2,888,039 18
Transmitted from Philadelphia and paid out in New York	1,060,000 00
Deposited for coins, and transmitted to Philadelphia	6,262,565 57
Entire deposit for 1854—gold	49,989,222 23
do do silver	5,871,753 82
Total coinage	60,756,503 82
Number of pieces	44,945,000 06
Amount of domestic gold	49,217,021 00
Of which amount from California was	48,892,794 00
Amount from Australia	432,000 00
Amount of silver coin struck and put into circulation in 1853 and 1854	17,273,451 00

Directors' Report.

CALIFORNIA GOLD FIELDS.

The yield of gold from California has indicated no variation except such as has been occasioned by the want of rain to supply water for the washing operations.

The following particulars from the *Calavaras Chronicle*, express, in a word, the advantage of an abundant supply.

Stewart's Hill.—Since the introduction of water to this place it is surprising to see the change which has taken place. It is now a scene of enterprise and industry. The exorbitant prices paid for water upon its first introduction here, was caused by a party who constructed a ditch to connect with the Chili Hill branch of the Mokelumne Company's Canal; purchasing the water from the Company and re-selling it to the miners. Upon complaint being made to the present managers—the embargo was removed by supplying the place with water through a conduit of their own, thereby abolishing a very onerous tax on labor, and conferring a substantial benefit on the miners. There are very flattering reports of success here.

The Union Water Company, which now takes the waters of the Stanislaus, is progressing very rapidly with their works; we are sure that there is no ditch company in the State of California whose promise for the present and the future can exceed that of this company. A little more than one year ago the company was severely embarrassed in their operations, being deeply in debt, and great fears were entertained that they would be obliged to assign their stock to pay their indebtedness. A new set of officers were elected, and a very energetic board of trustees composed. The change that has been effected through this new board of trustees is astonishing; but no more so than many things that occur in this magician land of ours. Through their influence and energy the character of the company has been made to take the first position in the State; the debts of the company are nearly all cancelled, and a stream of water has been added, which at all seasons and under all circumstances, will furnish an inexhaustible supply to one of the most extensive and richest mineral regions discovered in California.

Tunnels.—In Stockton Hill the miners still find rich diggings. There are a number of tunnels being worked here, which pay very richly. A small pile of dirt lying in front of one of them is so rich that the proprietors would not take $5,000 for it, yet it looks as if there were not a dozen cart loads in it. This is by no means an unusually rich claim.

Sport Hill.—This place, which is not more than two miles from Mokelumne Hill, in an easterly direction, is at present the scene of active operations. Quite a number of tunnels have been run into the hill at different points, in order to prospect the ground thoroughly before engaging in the great labor-saving system of washing by means of a hydraulic. Several companies are pursuing the work with great success, and others are ground-sluicing on the lower points of their claims, for the purpose of forming a breast of some depth, which is essentially requisite in successfully conducting hydraulic operations. These diggings are, at least, sixty feet deep, and pay from top to bottom.

Old Woman's Gulch.—The Mokelumne Hill Canal Company's new reservoir, recently built here, and which broke down while being filled the first time, in consequence of the alluvial nature of the soil of one of the natural banks of the gulch, has been thoroughly repaired, and will be of incalculable service to the miners located in this sequestered locality.

Bay State Ranch.—Near this place there is a large company of Portuguese sluicing the bank of the river; who, by means of a large wheel raise sufficient water from the river to supply their sluices. They are said to average ten dollars per day.

ROCKY BAR MINING COMPANY.

The annual meeting of the stockholders of this Company was held on February 7th, ultimo.

The following were then elected Directors for the ensuing year:—C. Satterthwaite, R. H. Williams, Harvey Everett, Samuel Stiles, E. C. Delavan, M. Brenan, Luther Elting, H. R. Cadwell, for New York; C. S. Seyton, for California.

The new Board of Directors subsequently organized, and elected Mr. C. Satterthwaite, President, Mr. E. C. Delavan, Treasurer, and Mr. M. Brenan, Secretary, for the year ensuing.

An assessment of two per cent. was laid payable on March 17th, except by California and English stockholders, who were to have one month's notice.

From this report we take the following extracts:

Progress of Works.—The Agent has prosecuted the works on Massachusetts Hill as rapidly as the means sent him allowed. By last advices (December

29th) they were so far advanced as to make him independent of weather. The engine shaft had been sunk twenty-five feet, and he expected to be down to water level (about fifty feet) on 1st January. The veinstone lies probably seventy feet below water level, so that it is necessary to have the pump at work before it is reached. The shears and poppet-heads were in their place over the shaft. The engine-house and boiler-shed was finished, being made large enough to hold a battery, which the Agent intends to erect as soon as he has the means, (cost about $8,000,) as it will save two thirds of the cost of crushing at other mills; he has bought a set of stamps at 4½c. a lb. The pump was on the hill; also the engine, which required alterations to reduce its velocity: the foundations would be completed in about a week, and then he would begin to set it. He had commenced to set the boiler, of which the loan had been continued to 1st October next: it required several repairs and alterations. The setting was to be finished in ten days. The rest of the work was to be prosecuted as fast as means allowed. The cost and time of sinking below water level were doubtful; but, if able to work without interruption, he hoped to be down to the lead in March. Before commencing works he had the claims all re-surveyed by the county surveyor, and stakes set fifty feet apart. He expected to sell all the water he could raise at 75c. to $1 per inch. In addition to the agreement made with the Agua Fria, four single holders had agreed to pay $100 each for drainage. Preliminary arrangements had been made to work the Southern claims in spring. These are the same lead as that on New York Hill, (mentioned below,) which lately gave $10,000 from 1,200 lbs. of quartz. He had raised thirty tons of rock from Gold Hill as a test; result not yet known.

Finances.—By the Agent's last estimate, a further expenditure of $7,440 was requisite, of which he had on hand $1,780 66, and has since received $847 88. The amount retained here is small enough for expenses in New York, and the Board have no more money to send him. How far the sale of water, profit on rock from Gold Hill and the Southern claims, and surface washing, with payments for drainage, may put him in funds, cannot yet be ascertained. In such works it is impossible to estimate cost precisely, as unforeseen causes of expense may arise; but, as the works advance, a more accurate judgment of expense can be formed, and it is expected that it will be known in a few weeks how much more money must be remitted. It will be remembered that the Board, on assuming office, found the Company without funds, and having estimated that $36,685 would complete the works, they called an assessment, which would have given that sum if all paid. To meet the convenience of many holders, (though by no means in accordance with the desires of the Board,) the assessment was divided into two; from the first of which only $14,523 75 has been received, and from the second only $8,061 60—in all, $22,585 35. It will thus be seen that a large proportion of the sum estimated has not yet been received.

Forfeited Stock.—The Directors have declared forfeited 15,527 shares, for non-payment of the assessment of two per cent.,—the number of shares now issued being only 80,616, representing, at par value, only $403,080. Although operations have been delayed by the non-payment of so many shares, those who pay will, in the end, derive a great advantage from the forfeiture. The Directors feel confident that a large number will desire to prosecute the undertaking; and, while they regret that any should lose their interest, it is clear that those only who duly pay up are entitled to the advantages of such payments. The unpaid shares will be sold at public auction, and the Board recommend the incoming Direction to buy them for the Company if the bids be too low.

Value of Quartz.—Since last Report quartz-mining in Grass Valley has received a great impetus, and at present an activity prevails hitherto unequalled. That the proprietors may judge of the value of their property, extracts from the Agent's letters are subjoined, all the places named in them being close to the Rocky Bar property. It should be borne in mind that it is now well as-

certained that quartz can be raised and crushed for $10 to $12 per ton, and that rock yielding $20 per ton pays well; any thing over that is coinage.

Mr. Seyton, the Agent, writes as follows, at various dates, from 29th of August to 29th of December:—

"All the mills, except Rocky Bar, are in full operation, and all are paying well. The Empire Company get from their claims on Ophir Hill, rock averaging over $50; for three weeks they took out $1,000 a day, and in six days they have taken out $10,000. They have a new battery of eight stamps, 1,000 lbs. each, and are enlarging their mill building. Osborne Hill rock pays from $20 to $60. The Gold Hill Company have a large force of miners in Gold Hill, and get twenty to thirty tons per day from that source. They likewise draw supplies from Jefferson Hill and other places. Their mill will now crush from forty-two to fifty tons in the twenty-four hours. The Helvetia and Lafayette Company are somewhat straitened for water, but they proceed as rapidly as they can. Mr. Conway's new mill (placed at the lead) is in course of erection, and will probably be completed before the rainy season sets in. A new vein has been discovered in Prescott Hill, and the greater part of the rock averages $100. Less than five nights' crushing at the Mount George Mills yielded ever $5,300. The French Company took out of a claim, which they bought for $250, a quantity of the richest quartz ever seen in the country. They struck a ledge underlying the one previously wrought, and less than 1,200 lbs. of the rock contained over $10,000. I have examined the rock myself, and can vouch for the value. A piece broken at hazard off one of the larger fragments, yielded the almost fabulous result of $50 to the lb. They have since taken other $10,000, in a few hours, from a pocket in the same vein. The average of the ledge is $35 to $40. This claim is on New York Hill, about one hundred yards from our Southern parcel of claims, and *the same ledge traverses both;* in ours it is under water. The other claims on New York Hill, and those adjacent to and surrounded by our Southern lot on Massachusetts Hill, are wrought continuously, and pay well. I have made preliminary arrangements with a party to work our Southern lot in spring. I have been repeatedly assured by men who have worked on Massachusetts Hill, (on which our works are now progressing,) that the rock belonging to us will yield over $60; and Mr. Conaway, whose claims are almost contiguous to ours, told me he never took rock from Massachusetts Hill that paid him less than $80. His claims are now wrought to the water level, and they got richer as he went down. Last week fifty tons, extracted from the claim held by Dr. Miller, in the centre of our Southern patch, were crushed at Mr. Atwood's mill, and yielded $47 50 per ton. The prevalent opinion of those who have seen our pump and the plan of operations is, that if means be supplied to build the works in a substantial manner, the Rocky Bar Company will be one of the most successful in the country. I can assure you of the accuracy of all the above statements, and you may conceive the impetus such results have given to quartz-mining."

AGENT'S RECEIPTS AND EXPENDITURES, FROM 14TH AUGUST TO 29TH DECEMBER, 1854.

Received.

Balance on hand 14th August, as per last account, ...	$708 30
Remitted from New York, $7,647 38; of which received to 29th Dec., .	6,800 00
Assessments paid in Grass Valley, ...	191 10
	$7, 699 40

Balance as above	$1,730 66
Remittance not yet acknowledged, (as above,)	847 38
To be accounted for, ...	$2,578 04

Expended.

Shaft, Buildings, Machinery and Works,	$2,356 98
Freight and Teaming,	235 63
Paid account Pump,	800 00
Salary, Board and Travelling Expenses,	1,596 21
Wages,	840 22
Office Expenses, Taxes, Advertising and Discount,	139 70
Balance 29th December, 1854,	1,730 66
	$7,699 40

By order of the Board,
M. BRENAN, Secretary.

RESEARCHES ON THE PACIFIC COAST.

An exploration somewhat brief of the coast above San Francisco, embracing a portion of Oregon, by Mr. N. Scholfield, presents some interesting facts, which we have gathered from his published communication:—

On returning from a few months' residence at the Umpqua River and its vicinity, in Oregon, during which time I have travelled from two to three hundred miles along the coast, and have also made some incursions in the interior, I propose to give a sketch of some of the geological and mineralogical features of the portion of the coast visited, as well as some practical observations relative to the beach gold washings, which occur along the shore in occasional deposits throughout the whole distance.

I left San Francisco, bound for Coose Bay, but, encountering very rough weather, and experiencing severe gales, we were tossed about for eight or ten days, and considered ourselves fortunate in reaching Crescent City, about one hundred and fifty miles south of our destination. Here a few of us procured mules, and proceeded up the coast by an unfrequented trail, through a country which, till recently, had been totally uninhabited except by Indians, and these were now in a state of excited hostility on some portions of the route. Here, then, our journey begins. I need not trouble you with the incidents of our travel, some of which were fully sufficient in interest and excitement for our own amusement, but will pass to the visible portrait of this 'terra incognita."

Crescent City is situated on the southerly side of a low promontory extending from the great coast range; the extremity of this promontory forms Cape St George, and consists of table land, elevated some fifty or sixty feet from the surface of the ocean. This table is underlaid by igneous unstratified rock, which appears mostly in boulders, as shown by the bluffs where they have become denuded by the disintegrating action of the sea, and by boulders composing a reef extending outward. On the north side, this promontory consists of low sands, and in the interior is a shallow lagune of considerable size. The southerly side, at the site of the town, consists of low timber land, scarcely elevated above the possible reach of recurring tides, or such as are always remembered in old countries by the "oldest inhabitant."

Looking southerly, we see the mountain gorge, where the Klamath debouches to the ocean, some ten or fifteen miles distant, and the "gold bluff," of notable memory, some ten miles further, while Trinidad head, about forty-five miles, appears dimly in the distance.

Travelling north, after leaving the low promontory, we pass along narrow borders of table land, with swelling hills in the rear, and occasionally mountain spurs and ridges come down to the shore, rendering some of the passes extremely difficult. Several large streams occur, which can only be passed by ferrying or swimming; rocky boulders occur all along in the bluffs, and frequently extend a considerable distance to sea. The rock is of an igneous character; basaltic trap and conglomerate occurring with little variation. In the beds of the streams which we passed are great varieties of pebbles, includ-

ing quartz, gneis, and many other varieties. This characteristic holds, with little variation, to Port Oxford, about thirty miles northwest from the mouth of Rogue River, or, as it is now called, Gold River, by authority of the Oregon Legislature.

From Port Oxford reaching some ten miles and including Cape Blanco is mostly table land, some portions of which has rather an undulating surface: continuing north some twelve miles are low sands extending some miles inland, but from thence to the Coquille River, about three miles, is a recurrence of the table land; this also continues with a little variation about ten or twelve miles further or near to Cape Gregory. This is a high bold cape with reefs of rocks; the rocks in this vicinity are mostly stratified sandstone. After passing the Cape we arrive at Coose River or Bay, passing which the geological features are suddenly changed; a sand beach, with low sand formation back, extends twenty miles to the Umpqua River, and continues twenty miles further to the Sinsclau, extending also about eight miles further to the high promontory whose western verge forms Cape Perpetua. Here then for a distance of about fifty miles we have passed by a hard sandy beach; unbroken, save by the rivers above named, with not a solitary rock on the shore or visible in the sea, for the whole distance. This sand formation extends inland varying from one fourth of a mile to three miles.

At Cape Perpetua is a recurrence of the igneous unstratified and conglomerate rock, which continues to a point about three miles north of the Alsea River, being about twenty miles north of Cape Perpetua. At this place the sand formation recurs and extends about twenty miles, beyond which another mountain range comes down and terminates at the sea shore, forming "Cape Foul Weather." The above is a hasty panoramic glance of the appearances along the shore; looking inland, these characteristics become all merged in one general confusion of mountains, peaks and ridges, whose only system or symmetry consists in their total irregularity. This feature holds through a width of from fifty to seventy-five miles, when the country becomes more open, and is variously carved and chiselled into mountains and valleys, here exposing the bright color of the precious ore to the delving of the hardy miner, and there spreading a green carpet, profusely studded with fragrant flowers, inviting the repose of the industrious husbandman and careful herdsman.

Recurring to the Pacific shore we find at various places along the beach deposits of gold, commingled with gravel and sand; this gold is mostly in fine scales, and always accompanied by black sand. The richest deposits yet discovered are those in the vicinity of Gold River, the Coquille, and Cape Blanco, at which places, especially the former two, they extend for miles along the beach, and some localities yield liberally to the persevering efforts of the miner.

And beside these localities, gold in small quantities and in fine particles, technically called "the color," exists all along on the shore, from Cape St. George to the Alsea River. I have found it at the Coose, the Umpqua, and the Sinsclau Rivers, and in the vicinity of the Alsea. It is known to exist further South than the limits of my examination, and I have no doubt they extend further North.

These deposits are found from one to three feet below the surface of the beach between the ebb and flow of the tides, and are covered at such depth with refuse sand and gravel. The gold thus deposited exists in a stratum of sand and gravel of an inch or so, to one or two feet in thickness, underlaid by a bed of blue clay or of hard gravel.

[To be continued.]

AUSTRALIA GOLD FIELDS.

The supply of gold from Australia is still abundant, although mining operations can hardly be regarded as having settled into a scientific and systematic method. There is a political uncertainty hanging over Australia, which must occasion some embarrassment to the rapid and scientific development of mining there.

SUPPLY OF GOLD FROM AUSTRALIA.

On this subject an extensive paper has recently been read by Mr. John Calvert before the British Association. His object was to show that the gold fields may be made to produce much larger returns than they do at present. He had been, he says, eleven years on that continent, and travelled over 21,000 miles of its soil solely for the purpose of determining its mineral characteristics.

In these expeditions he carefully investigated the auriferous sands, earths, veins, and other metallic formations, &c., and laid them down on maps. Having, likewise, so many assays from practical notes to refer to, he was enabled to arrive at something like an approximate estimate of the extent as well as of the richness of the auriferous soils of these three colonies—namely, South Australia, Victoria, and New South Wales. His estimate for the average yield of auriferous earth would appear very low, being only nine-tenths of a grain in the cubic foot; but, then, the extent he would place at 68,700 square miles, and which, he considered, would include all the gold fields worthy of that name in the three colonies, of which a portion only was at present worked, a large extent not being even known to contain gold, excepting from his investigations. The average depth of these auriferous strata would be about 39 inches, whether on the surface of the nearly bare rocks of the mountain top, or of the rich alluvial flats and river beds, which were, in many instances, upwards of 100 feet in depth. He had taken the mean average, although, as a general rule, the deeper the auriferous stratum was covered up the richer was the produce per ton of washing stuff. Supposing nine-tenths of a grain to a cubic foot, and the average depth of soil 39 in., over an area of ground comprising 68,700 square miles, the result would give 434,190 tons 2 cwts. 76 lbs., which at 3*l.* 19s. per oz., would be about 46,100,571,660*l.* The above estimate only included auriferous earth, alluvial debris and sands (as they now existed,) not any gold ores, granite rocks, quartz veins and metals containing gold, &c., which, if worked, would yield enormous wealth, and would, doubtless, if it were possible to estimate, be found to contain many times the amount given above. He had examined 238 gold quartz veins, which produced upon an average, for 20 fathoms down, where samples could be obtained at that depth, 2¼ dwts. per ton. One of these, which he called the Macquarrie vein, was an extensive one, or, as some might prefer to call it, a great many small ones forming one great system. He traced it for nearly forty miles across the country, running north and south, and in some places it contained a large per centage of gold. He obtained a large quantity of gold from this vein in 1849. This enormous vein would yield some millions sterling, provided the ores were treated properly, though he doubted very much if that be possible, with the processes as yet adopted. Another quartz vein that he discovered in 1852, although much smaller, was by no means behindhand in importance, as it contained the extraordinary average of from half per cent. to 28 per cent. of gold on the surface. Considering the extent and yield, this was the most wonderful fact relating to gold ever yet recorded in the annals of history. It was from this vein that he broke off 3 cwts. of quartz, which yielded 76 lbs. weight of pure gold, value about 3700*l.* Some people had named this Calvert's Bank; others had confused it with a rich discovery he had made to the west of the Snowy Alps. Some one asked if he intended to visit the spot again? He thought it very probable that, if he could possibly leave his present engagements, he should take a trip and visit it again; but he should have to choose his time, for it could only be approached in wet weather; he should get a few spirited young men to join him in the expedition. If the weather was favorable when he landed, he would be absent not more than 15 or 18 months, and when he returned he would astonish them all. The rich part was not more than 90 ft. long, and so capricious and local was gold, that he believed that at 10 or 12 feet from

the surface they would not find a speck; it would only show them how careful they ought to be when a rich specimen was exhibited as a sample of a large mass. This vein would come under a totally different class of diggings, and he might say the most precarious and difficult of all; for, occurring in deserts far away from inhabited ground, where there is no water, little or no vegetation, and that of the most sterile character, the almost impossibility of travelling under a burning sun in such a country, would protect, in a great measure, the gold that existed towards the interior of Australia. Then, again, it was more difficult to find, from not being torn up and dispersed over the country in alluvial debris, as in districts where rain fell regularly, and the abrasion of the rocks constantly going on; but when found, it was always richer, and of local existence. The difficulty of reaching such spots would ever preclude them from being systematically worked.

The way most of the present gold diggings were worked did not promise well for their maintaining their character for richness. A place is called worked out, and so left, whilst the diggers prospect through the country, and every new discovery acts as a tempting bait to the digger to leave the old one, and in time that sort of thing would give rise to a report that the diggings were falling off, and not so productive. They would not prove so productive to the roving digger, for each flood levelled all the ground before it, and filling in or tearing up the disturbed soil and rubbish, caused the remaining gold to be mixed throughout—a mass which the digger would give up as almost a hopeless and worthless undertaking to wash, and which accounted for the fact that, although there were at least three times the amount of diggers employed upon the ground than there were nearly two years ago, still the amount of gold was not greater. The argument to be drawn from his paper would be, that if the gold fields were left to the fate and control of the unscientific digger, the probability was that the supply of gold from Australia would greatly diminish. But if, on the other hand, large tracts of forsaken ground were properly worked by systematic companies, then he had no hesitation in saying that the supply would largely increase, and the disciplined labors of each man would give four times the result that they did at present.

As far as he was concerned, he was quite independent of mercury as a medium for obtaining gold, and he considered it a very costly one, although it had not been used, and was even now used in several parts of the world, with a profit; but then the stuff must be comparatively rich that would pay for mercurial treatment. He had been investigating all the methods that had been used, and had accumulated a mass of information on the subject—he might say he had a different process for every variety of mineral combination.

Economy had been the great point to arrive at. Some persons thought that if they crushed the ore fine they had arrived at perfection, but he would tell them that no crushing, however fine, would effectually or economically treat certain siliceous rocks.

Disintegration by decomposition was the great secret by which the poor quartz veins might be made to pay in many parts of the world. After a very laborious research, he had found out the method adopted by the ancients for extracting gold from their copper ores, which seems to be the introduction of iron plates into the fused metal, the melted copper having been previously alloyed, but by what substance he had not been able to discover, but did not think it was of much importance, as iron was of so opposite a nature to gold that it would always form the nucleus of collection, or precipitation, whenever the two metals came in contact, with a sufficiency of electric excitement, which would be the case if iron were thrusted into melted copper. It was as well to bear in mind that all metals, or alloys of metals, would have a tendency to crystallize at different temperatures, and even the same metal, supposing it to be placed under different electric circumstances. He would mention a method discovered by himself, which he called his electric decomposing process, for the extraction of gold; it had been a work of considerable time and labor to bring it to perfection. It was easy enough to decompose rocks by expensive chemical arrangements, and then by bringing an electric current of

an opposite nature to the metal required precipitation would immediately take place; but his object had been to work with cheap materials. Trials had been made with perfect success by using sewerage matter, with additional salt and lime, all of which could be obtained at little cost. He calculated he should consume 8000 tons of sewerage matter to every 970 tons of rock decomposed, but less would do if it were richer, and contained more ammonia; therefore, a much less proportion of night soil would do.

They must not think that because he used the word electric, that it was something dreadfully mysterious. He commenced with a chemical combination, introduced an electric agency, and left off with a chemical result. He was compelled, although unwillingly, to keep his process a secret at present, for he wished, if he were not robbed of it, to exercise the inventor's right over it. There were several persons who had already claimed to have invented his process, but were simply prevented from using it from the fact that they did not know how it was done, and were very much vexed because he would not tell them. He might keep them in ignorance a little bit longer, although he hoped soon to do something with it on a large scale.

THE GOLD QUESTION.

At the British Association, Henry E. Michel presented a paper, "On the results to be obtained by the scientific treatment of the abandoned workings of the Australian gold fields." We furnish only an abstract of this paper. The average rate of labor being 1*l*. per day, has caused the partial abandonment of auriferous strata whose results, operated on by the simple cradle, did not attain that limit; yet, under certain conditions, from 1 to 1½ oz. might be recovered per ton of earth. Opposed as I am to experimental quartz crushing, I believe that until the rail has bridged the gullies of Australia, and the tunnel penetrated her mountains, results which will pay for the expenditure necessary for that process can never be attained. But the solution of the great problem of the disintegration of the auriferous matrix by the electric current would at once render our quartz veins productive, and rank the scientific discoverer with the first men of the age. At present, with the aid of powerful machinery, the earth, clay, and stones carefully washed, exposed to the action of sieves moving horizontally under water, and afterwards carried down sluices, would, with the addition of the amalgamation process, recover all the contained metal. Companies failed hitherto from incompetent managers, unacquainted with the country or its requirements; machinery too heavy for transport was abandoned, and the tribute system, which is the best spur to mining energy, was ignored. Whilst abandoned ground can now be obtained on leasehold, companies can count on the assistance of the Colonial Government, anxious to develope the resources of the country, and it is a matter of surprise that as yet no steps have been taken in this direction. Sluice washing of the rudest nature without the aid of machinery, has been found on the Ovens to pay remarkably well, and is extensively practised, and new gold fields having opened up at Mount William, the Avon and the Buckland Rivers —the Bendigo, Ballarat, and Forest Creek districts having been partially drained of their occupants—no difficulty would be experienced in obtaining ground. Unlike speculative mining, results on this system could always be predicted with some degree of certainty, whilst errors would lie directly at the door of the manager. In no instance hitherto has the process been attempted on a large scale, whilst the new field thus open to adventure is of a magnitude which baffles calculation. From Bingarra to Bendigo, a distance of more than 1500 miles, auriferous gullies, each one of which would give employment to several engines, are to be found in profusion.

VIRGINIA GOLD MINES.

The gold mining interest of Virginia, it appears, is more extensive than many persons are aware. The Petersburgh Intelligencer gives a list embracing

fifteen of the most important mines, the aggregate value of which is estimated at $1,700,000. Of these, five are not worked, for want of capital, or because their ownership is disputed; and four are owned by English companies.

GOLD IN CANADA.

The *Toronto Leader* gives the following statement, based upon the report of Mr. Logan, the geologist, of mineral resources of Canada:

If Canada produces no coal, it has an abundance of the precious metals, and especially gold. Of this fact there is no sort of doubt. At the present moment, perhaps no greater calamity could befall the Province than the visitation of the gold fever. Nevertheless, the infection is here; and however much the fever may disturb the labor market, already submitted to a very violent action, there is no reason to fear that the passion for hunting gold upon the surface, and within the bowels of the earth will become as great here as it is in California and Australia. Mr. Logan showed me some ten pounds weight of pure gold, picked from the surface on the River du Loup, some sixty-five miles southeast of Quebec. The only alloy it contains is from eleven to thirteen per cent. of silver. It is therefore found in far too pure a state to be used in the arts, or coined without being alloyed with copper to make it of sufficient hardness. Of the gold in Mr. Logan's possession—which is not his property, however—eight pounds weight was in a bottle. The pieces were of various sizes, some of them very small, and many of them as large as an English horse bean. But in addition to this bottle of gold, there were several nuggets in a box, one of them weighing over half a pound. It is all surface gold that is in Mr. Logan's possession, having been picked up without the aid of any scientific process. Gold-bearing quartz, however, exists in abundance; but it is Mr. Logan's opinion, that, with unskilled labor, our gold fields cannot be rendered profitable. Mr. Logan has already stated in one of his public reports, that the gold country of Lower Canada extends over three thousand square miles.

He has since discovered, and will state in his next annual report, that it extends over ten thousand square miles. It is proper to state, that the ten pounds' weight of gold in the custody of Mr. Logan, cost as much if not more to obtain it than it is worth. Associated with the gold is found iridium, or white metal nearly as hard as diamond, used for the points of gold pens. It exists, however, in very insignificant quantities. A rumor has been in circulation that Mr. Logan had some pecuniary interest in our gold regions. Discrediting the statement, I mentioned it to him, and was informed that he had not a farthing's interest in any metal or mine in the country.

IMPROVEMENTS IN SEPARATING GOLD.

The improvement for which a patent was granted on the 16th January, to John S. Addison, for a new method of using quicksilver to extract gold from quartz or earthy matter, has for its object the distribution of such a quantity of quicksilver that the liquified paste of auriferous ore may be forced through it in a very finely subdivided state, so as to bring every particle in contact with it. Apparatus now in use for amalgamating gold with quicksilver, mostly operate on the principle of bringing the auriferous matter in contact with the surface of the quicksilver, hence they have to employ a very large quantity of mercury, or considerable of the gold may pass away in a free state. By this new process the mercury is distributed over the surface of strips or tubes of silver, or some other suitable metal so packed and arranged in any suitable vessel or receptacle as to leave small interstices between them, and to admit of the auriferous matter with a suitable quantity of water to permeate and flow through or between them.—*Scientific American.*

valuable known. We do not know how operations in the upper end of the country are progressing. That portion has always been regarded as the best of the copper *diggings.* The indications greatly surpass those of any other, both in the abundance and quality. They have taken out copper in nine places and that of a good quality. This was in the fall, what they have done since, and they have been working all winter, we are not prepared to say. They are now shipping ore more or less from the following places: Paint Bank, Early's, Gov. Brown's, Rhea's, Dalton's, Kincannon's, and nine places belonging to the Delphian Copper-mine Company, the respective names of which we do not know. At how many places they have simply cut copper, we do not know. All we can say is that the lead is twenty-five or thirty miles long; and there is no place in it but what the indications warrant a good copper-mine. Besides there appears to be a vein of yellow *sulphuret* probably, which lies between the Northern and Southern leads, on which a few shafts have been sunk; and at one of which, we were informed by a gentleman the other day, that Dr. Brown, of Cleveland, Tenn., obtained that kind of ore. The indications on this lead are not near so abundant as on the others, and in many places are nearly wanting, in others again, they are of a flattering nature. The formation geological would indicate the presence of other minerals besides copper, though there has been no one here who knew anything of mineral besides copper, and a great many knew but little about that. We invite the attention of men who are acquainted with gold, silver, lead, &c. to this country, for there is every reason to suppose these metals exist here as to suppose there is copper here; and no one longer doubts the existence of the latter though some hate to acknowledge it.

The result of the investigations have given the greatest satisfaction to those so engaged, and they have proved beyond their most sanguine expectations. The success here has excited our neighbors in the adjoining counties; some appear here nearly every week with a quantity of "specimens," insisting they have a copper-mine. We frequently have heard men who knew nothing about copper talk learnedly about indications, "*specimens,*" as they term it, and the like. A good many ludicrous adventures and laughable scenes have occurred during the explorations for copper. Our country has already felt its beneficial influence. There has been no scarcity of money here as in other portions of the country; things command the highest price; and a ready market is found at every farmer's door. The price of hauling has advanced; the quantity of plank needed cannot be got, though a steam saw-mill close at hand has been running day and night. The price for labor is greatly on the increase; there is a vast amount of work to be done and but few hands to be got at any price, in fact operations ceased in the fall for want of hands, and it has been but recently a good many Englishmen came in and a good many moved in from different sections of the country, that the operations were not almost stopped by those who were constantly leaving the mines. We have spoken to some length on this subject, in order to answer numerous inquiries made of us upon the nature of the copper-mines in Carroll; a reply by way of letter our time would not admit of, and we have given the facts without exaggeration.—*Torrent, Hillsville Virginian.*

MINERAL CONTENTS OF THE LOWER SANDSTONE OF THE UPPER MISSISSIPPI. CONDENSED FROM DR. OWEN'S GEOL. SURVEY OF WISCONSIN.

According to Dr. Owen's experience in other mining districts, the country over which this light colored quartz ore sandstone prevails, is not likely to be very productive in mineral deposits; yet between the Mississippi and Kickapoo Rivers, on the southeast quarter of Section 27, Township 10, North Range 5, west of the 4th Principal Meridian, copper ore has been discovered, not, however, in immediate connection with the sandstone. The wall-rock to which the ore was traced, and which bounds it on the south-east, is a magnesian limestone, possessing all the characters usual in the lead and copper localities of the rich Mineral Point district.

This copper ore has a light green color, waxy lustre and fracture, and very brittle, disseminated through ferruginous earthy matter, composed chiefly of brown oxide of iron. The following is the analysis by Dr. Owen, of this ore, in the usual way, gave from a gramme:—

Water,	11·2
Carbonic acid,	05·0
Insoluble silicates, traces of oxide of iron,	08·3
Protoxide of copper,	25·0
Peroxide of iron,	48·7
Protoxide of manganese,	00·2
Alumina,	00.6
Carbonate of lime,	00·8
Loss,	00.2
	100·0

=19·87 per-cent. by calculation, of metallic copper.

Smelted by Wm. Preston, at Mineral Point, it yielded 23 per cent. of metallic copper, being only three per cent. more than the result of Dr. Owen's analysis.

This ore was first discovered by a Mr. Sterling, in March, 1843, on the north slope of a hill, the foot of which is watered by Cooper Creek, a small tributary which runs west into the Mississippi, four and a half miles from the Kickapoo. It was explored by Mr. Sterling, and proved to be a bed from 12 to 15 feet wide, and five to seven deep, spreading out as it descended the slope, to 30 feet wide, and conformable to the outline of the hill. On tracing it to the south, it was followed to near the brow of the hill, where it pitches to the south-east, parallel with a wall of magnesian limestone, and almost perpendicularly. The wall of magnesian limestone is quite solid, and without apparent stratification. A shaft of 50 feet was first sunk from the surface; then a drift of 90 feet was run on the west side of the perpendicular wall of rock; and afterwards another shaft of 12 feet at the end of the drift. To the north, a gallery was run 40 feet, and six feet sunk perpendicularly; the copper ore extending both horizontally and vertically, as far as these excavations were carried.

The mine lies well for drainage, and the ore is of a kind easily reduced in the furnace, and yields so good a per centage of copper (about 20 to 23 per cent.) that it would be well worth the expense to prove this mine further than has yet been done, so as to determine to what extent the ore traverses the magnesian limestone before entering the sandstone, in which latter formation the vein would probably dwindle, or entirely disappear. Mr. Sterling has transported 24,000 lbs. of the ore to Mineral Point, and had it smelted, with the results as given above.

Carson & Sterling, of Mineral Point, subsequently discovered copper ore of a similar quality on the same quarter section, only 800 yards north of the ore bed just described.

On Section 1, Township 12, and Range 4, east of the 4th Principal Meridian, copper ore has been found, in the vicinity of the Baraboo River, disseminated in pockets through brown ferruginous beds of sandstone, occurring towards the base of F 1. It is a green carbonate and silicate of copper, similar in character to that occurring near Mineral Point.—*Owen's Geol. Survey.*

Copper Ore in the Lower Magnesium Limestone.—Between Plum and Pine Creek, in the south-west corner of Section 26, Township 8, North Range 5, west of the 4th Principal Meridian, on the south-east slope of a hill, copper ore, associated with hematite, was found, and traced into a crevice traversing the lower cherty beds of the formation; also four miles beyond, in a N. N. W. direction, on the slope of another hill, copper ore was picked up, and yielded, by analysis, from 17 to 23 per cent of copper.—*Dr. Turnbull.*

MINERAL WEALTH OF GEORGIA.

Messrs. Locket & Snellings, of this city, have within the few days past received two consignments of copper ore from the Sally Jane Copper Mines in Fannin County, in this State, being the first shipment of copper ever made from Georgia. The Sally Jane Mines are only distant about two miles from the Polk County Tennessee Mines, and are said to be very productive. They are owned and worked by Messrs. Smith, Lawerson & Co., who have established the agencies in this city and New York, for the forwarding and sale of the ore, and have made all the necessary arrangements for going extensively into the copper mining business. The Georgia mines were, we believe, originally discovered and purchased by Mr. Wm. G. Smith, of Morgan County, who with his partner, Mr. Lawerson, have had considerable and successful experience in mining in California. We take pleasure in recording this new development of the mineral wealth of our State, and sincerely hope that the enterprising firm who have entered upon this new pursuit in Georgia will realize their most sanguine expectations. There can be no doubt that there are rich deposits of copper in the mineral region of this State, and we shall not be surprised to see the ore become an important article in the list of Georgia exports. —*Sav. News.*

Of the per centage of this ore the Cassville *Standard* thus reports:

We have in our office several specimens of copper ore from the "Sally Jane Copper Mine," in Fannin County. These specimens were handed to us by Mr. W. G. Smith, one of the proprietors of the mine, and, at our solicitation, were left with us to be exhibited to any one having an interest in developing the hidden treasures of our mountain country, or to the scientific for the gratification of their curiosity.

We are advised that this, the Smith, Sanderson & Co. Copper Mining Company, is the first mine in this State from which copper was taken and shipped to Baltimore. Its yield there was from 25 to 40 per cent. The mine is supposed to be inexhaustible, and were capital invested to the extent it should be in this enterprise, there is no telling what amount of wealth would not, in a few years, be the reward of its possessors.

MINING IN SOUTH AUSTRALIA.

The following is the approximate return of copper and lead ore raised in South Australia since the first discovery of metalliferous deposits:—

COPPER MINES.

Burra Burra	tons 92,284	Kapunda	tons 12,650
Karkulta	75	Princess Royal	588
Kaumantoo	3,441	North Rhine	100
Ditto (leased portions)	560	Port Lincoln	550
Paringa	512	Royal Mining Company	60
Ditto (leased portions)	300	Dutton's Mine	50
Montacute	2,000	Strathalbyn	} 250
Adelaide	500	Breadalbyn	
Enterprise	200	Glenalbyn	
Reedy Creek	1,200		
South Kapunda	200	Total	115,520

SILVER LEAD MINES.

Glen Osmond	tons 1,009	Wheal Brothers	tons 40
Wheal Watkins	1,000	Belvidere	100
Wheal Gawler	90		
Wheal Grainger	70	Total	2,429
Wheal Margaret	120		

The value of 115,520 tons of copper ore, $75 per ton, would be $8,664,000; and of 2,429 tons of silver lead ore, at $60 per ton, $145,740; making altogether a revenue of $8,809,740, already derived from the mines of that country. The bulk of these ores was produced between the years 1844 and 1850. We are assured that, reckoning every person employed (including men, women, and children,) in raising and preparing ores, the mining population of the colony, even before the gold fields were discovered, never exceeded 3000 souls, so that the aggregate returns of their productive industry in those years averaged nearly $3000 per head. It should be bórne in mind that nothing approaching to a state of exhaustion has resulted from such extensive productiveness. The Burra Burra, which has yielded so large a proportion of the aggregate above mentioned, is still rich in the quality of its ores, in its manifestly great productive capabilities, and in the prospective wealth which is more than likely to confirm the most flattering predictions of practical and scientific men. The Kapunda ores have averaged full 21 per cent., and at this rate, the produce of the mine must have amounted to the large sum of $1,138,500. Even in 1848, as many as eight lodes had been discovered, and were all producing ores of good quality; and as the mine is technically, and no doubt truly, described as "only just coming into a good course of working," it is difficult to form an estimate of its value, or the extent of its future productiveness.—*London Journal.*

JOURNAL OF SILVER AND LEAD MINING OPERATIONS.

LEAD IN SOUTH WEST MISSOURI.

Little is known in this part of our country relative to the lead mining operations in South-western Missouri. The following facts, we are assured, have been prepared with care, by Mr. G. W. Moseley, of Neosho, in Newton Co., and furnished to the Western Journal:

GENTLEMEN:—I have just been making out some accounts for Professor Swallow, in regard to the minerals and mining operations in South-west Missouri. I have thought that you would like to have a correct account of the amount of mineral raised and smelted in this new mineral region of Missouri. The following statements may be relied on. I have put myself to a good deal of trouble to collect the facts, and if you deem them of sufficient importance to give them a place in your valuable journal, you will oblige me, and save me a great deal of trouble in answering letters of inquiry from various places.

The first smelting of Galena lead ore in South-west Missouri, was commenced in the year 1850 by Mr. A. Spurgeon, on Section 32, Township 26, Range 32, in Newton County. Mr. Spurgeon raised from this section 226,000 pounds ore, which he smelted in log furnaces in the years 1850 and 1851. The log furnaces used in this country were generally constructed on the side of a hill. They were made 8 feet wide, 10 feet long, 6 by 8 feet in the clear, and the walls about 5 feet high. In the front of the furnace was an eye, say 2 feet square, through which the fire was stirred, and out of which the lead run when melted. The bottom of the furnace was laid with flat stone, the wood was prepared by cutting large logs to drop in the furnace, together with some dry wood, the mineral being mixed with the wood, after being washed in a common trough made from a hollow tree. The furnace being charged in this way, the fire is kindled, and the melted lead caught in a common Dutch oven.

This mode of smelting produced some 80,000 pounds of lead, sold for $4,000, and yielded about 35 per cent. This lead was generally peddled out in the small towns and in the Indian country on our western border.

In the year 1850, Moseley & Co., of Neosho, built a furnace known to smelters as the Drummon furnace, situated near to Moseley's Mines. On this furnace G. W. Moseley & Co. smelted from their own mines on section 35, township 26, range 32, in Newton County, 250,875 pounds of lead ore, and 25,000 pounds purchased at other mines. The mineral smelted in this furnace yielded a fair per cent.; (the lead being shipped to New York and Boston.) In the fall of 1851, G. W. Moseley & Co. commenced building a blast furnace, with two stacks, propelled by water-power, and on the 9th day of February, 1852, they completed this furnace, at a cost of $3,000. They smelted from the Moseley Mines, 142,500 pounds of ore; from Center Creek, in Jasper County, 99,074; and from Turkey Creek, in Jasper Co., 95,073.

In July, 1853, this blast furnace went into the hands of the Moseley Lead Manufacturing Company. They smelted from the Moseley Mines, 110,500, and from Oliver's Prairie, in Newton Co., and Center and Turkey Creeks, in Jasper Co., 93,000 lbs. of ore.

In Jasper County, Mo., Mr. Harklerodes erected a blast furnace, single stack, in the early part of the year 1853; and from the best information that I have, has smelted, since he commenced, from Center and Turkey Creeks, in Jasper County, and Oliver's Prairie, in Newton County, some 800,000 pounds of ore. The amount of mineral that is at present on hand, and which will be ready for delivery by the 20th of December next, is estimated at 200,000 pounds.

Since the commencement of the lead business in 1850, up to the 20th December, 1854, we show of the ore raised 1,551,022 pounds. Until this last spring, the lead has been transported, say from Moseley's Furnace to Moseley's Landing, on Grand River, in the Seneca nation, by wagons, at 25 cents per 100 pounds, and thence by flatboats to Fort Smith, at a cost of 40 cents per 100 pounds, and thence to New Orleans by steamboat. G. W. Moseley & Co. had their lead always insured on flats, with privilege of reshipping, at a cost of 2½ per cent. on its value at New Orleans. The usual price of freight from Fort Smith to New Orleans is 50 cents per 100 pounds. G. W. Moseley built their own flatboats, and hauled the lumber fifty miles. The three years that they shipped their lead down Grand River, their bills of lading date in May and July in each year, they have shipped from 800 to 1,000 pigs of 70 pounds each, upon a single boat. It is said that boats could go with much larger loads; one season they shipped on thirty feet water. There are several objections to shipping by Grand River; first, its location in the Indian country; secondly, the great difficulty of getting lumber; and thirdly, the river can only be relied upon in May and July of each year.

If persons engaged in the lead business had a sufficiency of capital to purchase mineral and hold on to the lead until these periods arrive, say May and July in each year, lead could be sent much cheaper than by Boonville to St. Louis. For instance, the same boat that carried 1,000 pigs to Fort Smith, could be made with very little additional expense to carry 2,000 pigs with equal safety. Since the Seneca country has been tréated for by our government, mills will be erected to saw lumber; all these things will still lessen the expense, and I think, without a doubt, that lead can be delivered at New Orleans from this country for 80 or 85 cents per 100 pounds by this route. The Moseley Lead Manufacturing Company sent their lead to St. Louis last spring by Boonville; transporting it to Boonville on wagons, at $1 per 100 pounds, and thence by steamboats, at a cost including charges of storage, receiving, forwarding, insurance, freight, &c., of 25 cents per 100 pounds.

It is a safe calculation to say that 1,000 pounds of good lead ore, smelted in the blast furnace, will yield 650 pounds of lead; this, at the present prices in St. Louis, 6 cents, will be $39 00. Cost of transportation to St. Louis, at 1¼ cents per pound, will be $8 12½. The 1,000 pounds of ore in the Galena mines, in Illinois, will yield the same, 650 pounds, and be worth in St. Louis $39 00. I suppose that lead can be shipped in Galena at 30 cents per 100 pounds; this would be $1 95 for each 1,000 pounds of the ore; this will make a difference

of $6 17½ in favor of the Galena smelters. For example, if in Galena mineral is worth $30 00 per 1,000 pounds, it is only worth here in South-west Missouri $23 82½. Thus, it will be perceived, that should lead again go down to a price that would depress the value of mineral at the Illinois mines to $15 00 per thousand pounds, it would be worth only $8 82½ per thousand in South-west Missouri, which would be discouraging to the miners of this region. Yet so long as we have to haul in common wagons to Boonville, this state of things will exist. Furthermore, it is only a limited amount of lead that can be sent to St. Louis, even at the rate of one dollar and twenty-five cents per hundred pounds. For instance, I say to a wagoner, sir, I have a load of lead to send to Boonville, and I would be glad you would start in three days. His reply is, have you a back load? I answer, no. Then, he says, I cannot haul it unless I can get a load of goods to haul back for some of the merchants; if you are very anxious for your load to go, and I cannot get a load to haul back, I will take your load, if you will pay me $2 per 100 pounds, the Boonville prices to Neosho at this season of the year; but if you will wait until my team can live on grass, I can afford to haul for $1 50 per hundred. These are prices which the owner cannot afford to pay, and, of course, the lead remains on hand.

G. W. Moseley & Co. have sold their lead in Boston and New York, where they obtained the same prices paid at the time for Illinois lead. Our best mineral, when analyzed, is found to contain 85 per cent.; no other district in the United States, I believe, produces richer ore. I should think all assayers would be satisfied of this, were it not for what I once saw not a hundred miles from our city. A gentleman who had been travelling through our section of country, and also through the Washington and Madison County Mines, and had lived for many years near the latter, was exhibiting to the President of a corporation the different specimens of ore, and among them one from the Moseley Mines, of this county. While the President was carefully examining each specimen, the gentleman called his attention to one from his own favorite home, and said, this is the best specimen I have seen; this will yield 90 per cent. of pure lead. I sat in silence, and thought to myself that the President would correct the gentleman, but he did not.

Our mineral region embraces the counties of Jasper, Lawrence, a portion of Grundy, Barry, McDonald, and Newton, in Missouri; the country claimed by the Quapaw, Seneca, and Shawnee Indians, the north-eastern portion of the Cherokee country, and through North-west Arkansas. There cannot be a doubt but this country is the most extensive mineral region in the United States.

I have endeavored to give you a fair and honest expose of this country, representing it as it is, with its advantages and disadvantages. Give this country a railroad, and its mines, when fully developed, will send more lead to St. Louis, than Iowa, Wisconsin and Illinois send to that and every other market.

COALS AND COLLIERIES.

ANTHRACITE COAL TRADE FOR 1855.

	Tons.
Shipments from Richmond to March 10th,	138,122
Same time last year,	126,580
Amount shipped by Railroad to March 16,	376,318 15
" " by Canal,	10,086 09
Total,	386,405 04
Same time last year,	355,033 04
Increase	31,372

RATES OF TOLL AND TRANSPORTATION ON RAILROAD, TO JUNE 30, 1855:

	From Mt. Carbon.	*S. Haven.*	*Pt. Clinton.*	*Auburn.*
To Richmond,	$2 00	$1 95	$1 80	$1 75
To Philad'a,	1 90	1 85	1 70	1 65
Spring Mills,	1 65	1 00	1 45	1 45
Reading,	1 20	1 15	1 05	1 05

RATES OF TOLL BY CANAL TO JUNE 30, 1855.

	From Pt. Carbon.	*Mt. Carbon.*	*S. Haven.*	*Pt. Clinton.*
To Philad'a,	80	79	77	65

RATES OF FREIGHT BY CANAL.

	From Pt. C. & Mt. C.	*S. Haven.*	*Pt. Clinton.*
To New York,	$1 90	$1 85	$1 80
To Philad'a,	90	85	80

Richmond, March 23.—Freight to Boston,	. . . . . .	$2 00
	To New York, ...	$1 00
	To Providence, ...	$1 25 to $1 50

CUMBERLAND COAL TRADE.

Amount shipped to March 3d., ... 40,247 05

PRICES OF COAL.

The demand for coal opens very fair—and prices range from $1 to $1 25 per ton less than the September prices of last year, so that consumers will be supplied with fuel, considerably cheaper this year than last, a "consummation devoutly to be wished" by purchasers, and even by producers, who do not desire high prices for coal, if it can be avoided.

The price for best quality White Ash Scuylkill Coal, on board at Richmond, is $4 50, and Red Ash $4 75. Inferior qualities range a shade less. By Canal the prices range here from $2 25 to $2 50 per ton, delivered in Boats.

The price of Lehigh Coal on board at Bristol, has been fixed at $4 75—Stove Coal $5 per ton.

At Rondout the price on board is $4 80, and delivered in New York, $5 30 per ton. The Pennsylvania Company, we presume, will adopt the same rates.

The rates of toll and transportation by the Philadelphia Railroad, are 30 cents per ton higher than the opening rates last year. The toll on the Schuylkill Canal is only ten cents per ton advance on last year's rates, and freight to New York is also ten cents a ton higher than the opening rates of last year.

The Lehigh Canal will not open much before the first of April—and the Delaware and Hudson Canal before the middle of April. The boatmen on the Lehigh have fixed their freights from Mauch Chunk to Philadelphia at 96 cents per ton, 10 cents higher than the opening rates last year. The freights from Port Carbon to Philadelphia are 90 cents a ton, and from Schuylkill Haven 85 cents per ton.—*Pottsville Journal.*

FREIGHT ON COAL.

The Wilkesbarre *Times* notices a meeting of boatmen of the North Branch recently held in that Borough, at which the following tariff was agreed upon for the opening of trade, and it was resolved that no boatman would load coal at lower rates until formally altered by agreement. It was also agreed that twenty cents additional per ton must be charged if the extra one mill per ton was not taken off by the Canal Commissioners. We took some pains to learn the highest rates paid to the various points last fall, and give them as stated by different boatmen, in nearly all cases as received by themselves, so they may be relied on. Boatmen say prices were pushed up extravagantly high last season, and it will be seen that they were not regulated by any reasonable rule,

one boatman getting $3 10 to river at Columbia, while another got only $3 to Wrightsville. The proceedings were calm and temperate, although considerable feeling was manifested at the interference with freights by operators, while insisting on full prices for coal at the wharf. The following are the list of prices agreed upon:

	Freight from Pittston.	W. Barre, Plymouth.	Nanticoke.
To Bloom,	$ 90	$ 80	$ 75
" Danville	1 00	90	80
" Duncannon,	1 60	1 50	1 45
" Harrisburg,	1 75	1 65	1 60
" Middletown,	1 85	1 75	1 70
" Marietta,	1 95	1 85	1 80
" Columbia Basin,	2 00	1 90	1 85
" Columbia River,	2 10	2 00	1 95
" Wrightsville,	2 20	2 10	2 05
" Safe Harbor,	2 40	2 30	2 25
" Havre de Grace,	2 60	2 50	2 45
" Baltimore,	3 10	3 00	2 95

Highest freights last season:

To Bloom,	$0 95	To Columbia Basin,	3 05
" Danville,	1 12½	" " River,	3 10
" Duncannon,	2 36	" Wrightsville,	3 00
" Harrisburg,	2 50	" Safe Harbor,	3 75
" Middletown,	2 70	" Havre de Grace,	4 10
" Marietta,	3 05	" Baltimore,	4 40

Rates fixed by operators at their meeting on the 15th day of January:

From	Per Ton.
Wilkesbarre and Plymouth to Bloomsburg,	$0 75
" " " " Danville,	0 85
" " " " Duncannon,	1 45
" " " " Harrisburg,	1 60
" " " " Middletown,	1 67
" " " " Marietta,	1 80
" " " " Columbia Basin,	1 83
" " " " Columbia River,	1 90
" " " " Wrightsville,	1 95
" " " " Safe Harbor,	2 15
" " " " Havre de Grace,	2 35
" " " " Baltimore,	2 75

COAL STATISTICS.

We are indebted to Mr. Robert G. Rankin for the following tables, compiled from various sources, to accompany his Report on the Cumberland Basin.

The inaccuracy of many of our *public* reports deprives their tables of much value. One *Legislative* report is now before the writer, containing an error of *millions* in a given item. Care has been taken in these tables to make them reliable, by correcting the detected errors of the reports.

Each of the tables has an immediate or prospective relation to the coal trade. They afford the owner of coal lands—the miner—the transporter—the coal merchant—and the consumer, a measurably ample means of forming a correct judgment of the present and future values of their respective interests.

The tables and statistics of canal rates are compiled from data furnished by the Annual Report, February, 1854, of W. I. McAlpin, Esq., late State Engineer of the State of New York. The well-known statis-

tical accuracy of Mr. McAlpin gives to his dicta an almost apothegmatic force.

In his characteristics of the different modes of transport on land and water, he says: "Their comparative advantages involve an examination of the *cost* and *charges* of transport by each."

"The *charges* cannot be relied on, because they fluctuate on the various routes, and on different articles conveyed; competition reducing them to a minimum, and monopoly raising them to a maximum."

The *cost*, however, furnishes a more reliable basis for comparison, as the elements on which it depends are usually affected alike on the different routes.

These elements consist of *loading*, conveying, discharging, warehousing, insurance, and on artificial channels, the necessary expenses of maintenance, and to repay the cost of construction.

"The *cost of loading* and *discharging* depends upon the price of labor and facilities afforded; and the *cost of insurance* upon the character of the navigation."

The cost of *movement upon a canal* depends upon the relative sectional areas of the boat and the canal, upon the actual size of the two, and upon the elevation to be overcome.

"The *cost* of movement upon a railroad depends upon the amount of the curvatures, the inclination of its gradients, and the elevation to be overcome, and its limited capacity in comparison with its cost."

The cost of transport on artificial works is increased by the tax necessary to be levied to give a remuneration for the capital invested, and also to pay the current expenses of operating and maintaining the work.

EXTRACTS FROM MR. MCALPIN'S TABLES.

Cost of Transport per Ton per Mile.

	Mills.
Ocean, long voyage,	1
" short "	2 to 4
Lakes, long voyage,	2
" short "	3 to 4
Rivers, Hudson, and of similar character,	2.5
" St. Lawrence and Mississippi,	3
" Tributaries of Mississippi,	5 to 10
Canals, Erie, enlargement,	4
" other, large but shorter,	5 to 6
" ordinary size,	5
" " " with great lockage,	6 to 8
Railroads, transporting coals,	6 to 10
" not for coal, favorable lines and grades,	12.5
" " " " steep grades,	15 to 25

The capacity of the Erie Canal, as originally constructed, was equal to one and a half millions of tons carried through. Its dimensions were fixed at forty feet surface, and four feet depth, with locks ninety feet long and fifteen feet wide. Its enlarged capacity was fixed at seventy feet surface, seven feet depth, with locks one hundred and eighteen feet long and eighteen feet wide, and equal to the movement of seven millions

of tons through. For the capacity of the Ohio and Chesapeake Canal see the reports of that canal in another part of this report.

Mr. McAlpin says the cost of transportation on the Erie Canal, *including* its *repairs* and maintenance, and the expenses of the forwarders, is *five mills per ton per mile.*

The *cost* of transportation of freight on the Central Railroad, including items of expense, corresponding to those above stated, was *nineteen mills per ton per mile;* and, on the New York and Erie, was *thirteen mills.*

The *charges* for transportation of all the freight in the canals in 1853, including the tolls paid to the State, averaged *one cent and one mill per ton per mile.*

The charges for the transportation of all freight on the Central Railroad averaged *three cents and four mills per ton per mile;* and, on the New York and Erie, averaged *two cents and four mills.*

Table, showing charges for transportation on the principal Water and Railroad lines, according to the Report, dated February, 1854, *last published rates.*

	Per ton of 2,000 lbs. per mile.
FROM NEW YORK.	
Hudson River,	.7
Erie Canal,	1.1
Western Lakes, short voyage,	1
" " long "	.5
New York and Erie Railroad,	2.4
Hudson River Railroad,	3.1
New York Central Railroad,	3.4
Western Roads, from Buffalo to Chicago, average,	2.5
FROM BOSTON TO WESTERN LAKES.	
New England Roads, from Boston to Rouse's Point,	2.7
Northern Road, Rouse's Point to Ogdensburgh,	2
Lake Ontario and Welland Canal,	.7
Western Road, Boston to Albany,	2.3
FROM QUEBEC.	
St. Lawrence Rivers and Canal,	.6
FROM PHILADELPHIA.	
Pennsylvania Canal, to Pittsburgh,	2.4
" Railroad, " estimated,	3.5
Ohio River,	.8
FROM BALTIMORE.	
Baltimore and Ohio Railroad, general freights	3
" " " " coal,	1.3*
FROM NEW ORLEANS.	
Mississippi River, Lower,	.6
" " Upper,	.9
Ohio Canals,	1.
Wabash and Erie Canal,	1.9
Illinois Canal,	1.4
" River,	1.2

Cost of Coal at Panama, and Charges of Transport.

The California steamers generally use the Cardiff coal, from Wales, England.

Average cost in England, ...	$3 60	
" freight to Panama, . . .	20 00	
" contingent expenses, ...	2 36	
" cost, without profit, at Panama, .		$25 96

CUMBERLAND COAL.

Average price at Baltimore, ...	$4 50	
Freight to Panama, ...	5 00	
Tolls, Panama Railroad, in bags, $7, in bulk, $9, ...	9 00	
Contingent Expenses, ...	1 85	
Cost at Panama, ...		$20 35

A pure Cumberland coal has at least 20 per cent. more durability and steam-generating power than the Cardiff.

Shipments of Coal from Pictou to the United States, to August 25th, 1853.

Years.	British Ships.	American Ships.	To Brazils, in American Ships.
	Tons.	*Tons.*	*Tons.*
1846	28,000	30,303	
1847	49,635	41,393	240
1848	43,225	33,333	
1849	43,350	25,335	
1850	49,450	21,903	
1851	35,174	8,558	
1852	35,277	18,325	1,070
1853	35,000	9,000	
	338,611	188,300	1,310

A letter from Pictou, of September 7, 1854, says: "There are 85 sails of vessels in port, amounting to 14,000 tons, all waiting their turn to load; and as the mines can only furnish 250 chaldrons per day, it will be the 1st day of December before many of the present fleet will be able to leave. Several vessels have left in ballast, and more will have to do so, or winter here." There is, probably, an error in the amount of delivery from the mines; and the yield is nearer 450 tons daily.

The coal lands of Nova Scotia were all claimed by the English government, who sold the exclusive right of mining to the Duke of York for sixty years, of which about twenty-five years are yet unexpired. The

Duke of York sold them to his creditors, in payment of his debts; and they formed themselves into the Albion Mining Company, who now enjoy and exercise the *exclusive right* to mine *all* coal and *minerals* in Nova Scotia.

Under such circumstances, but little apprehension need be feared of any unfavorable competition between the Pictou and our Cumberland coals under the operations of the reciprocity treaty.

In point of supply there can be no comparison; and for river and sea steamers' use the latter is preferable at double the price.

Production of Anthracite Coal, 1820 *to* 1854.

Year.	Annual Supply.	Increase.	Rate per Cent.
1820	365		
1821	1,073	708	194
1822	2,240	1,167	109
1823	5,823	3,583	160
1824	9,541	3,718	64
1825	34,893	25,352	265
1826	48,047	13,154	$37\frac{1}{2}$
1827	63,434	15,387	32
1828	77,516	14,082	22
1829	112,083	34,567	44
1830	174,734	62,651	56
1831	176,820	2,086	$1\frac{1}{4}$
1832	363,871	187,051	106
1833	487,748	123,877	35
1834	376,636	111,112 dec.	23
1835	560,758	184,122	49
1836	682,428	121,670	$21\frac{3}{4}$
1837	881,476	199,048	29
1838	739,293	142,183 dec.	16
1839	819,327	80,034	11
1840	865,414	46,087	$5\frac{1}{4}$
1841	958,899	93,485	$10\frac{3}{4}$
1842	1,108,001	149,102	$15\frac{1}{2}$
1843	1,263,539	155,538	14
1844	1,631,669	368,130	29
1845	2,023,052	381,383	24
1846	2,343,992	320,940	$15\frac{3}{4}$
1847	2,982,309	638,317	27
1848	3,089,238	106,929	$3\frac{3}{4}$
1849	3,242,866	153,628	5
1850	3,356,899	114,033	$3\frac{1}{2}$
1851	4,383,730	1,026,831	$30\frac{1}{2}$
1852	5.018.346	634,616	$14\frac{1}{2}$
1853	5,114,491	96,145	$1\frac{9}{10}$
1854	5,932,809	818,318	16

Average for last five years, $13\frac{29}{100}$ per cent.

Production of Cumberland Coal Basin, 1846 *to* 1855.

Year.	Annual Supply.	Increase.	Rate per Cent.
1846	11,758		
1847	52,940	41,182	350
1848	79,571	26,631	50
1849	142,449	62,878	79
1850	196,848	54,399	38
1851	257,659	60,811	31
1852	334,178	76,519	30
1853	533,980	199,802	59 $\frac{7}{10}$
1854	721,871	187,981	35
Average for five years, 38 $\frac{7}{10}$ per cent.			

Statement prepared by C. Slack, Esq., Superintendent of the Cumberland and Pennsylvania Railroad Company, of the quantity of Coal forwarded from the several points in the Cumberland Coal Region during each month of the year 1853.

Month.	Jennings Run.		Braddock Run.		Piedmont Region.	Aggregate.	
	Railroad.	Canal.	Railroad.	Canal.		Railroad.	Canal.
January,	11,645	1,023	10,105	1,451	For the season.	21,750	2,474
February,	7,760	660	7,310	559		15,070	1,219
March,	11,909	9,896	11,102	7,198		23,011	17,094
April,	11,703	12,794	11,923	7,148		23,626	19,942
May,	12,260	13,384	8,038	9,165		20,298	22,549
June,	13,771	7,516	7,897	5,573		21,668	13,089
July,	14,830	2,390	10,603	3,262		25,433	5,652
August,	13,839	9,213	16,875	8,383		30,714	17,596
September,	12,065	7,966	19,888	7,004		31,953	14,970
October,	12,548	7,390	14,900	7,366		27,448	14,756
November,	13,404	8,016	19,328	8,510		32,732	16,526
December,	14,648	3,812	17,309	4,916		31,957	8,728
	150,382	84,060	155,278	70,535	70,560·3165	376,220	157,760
Total for the year, . . .							533,980

STATEMENT

Showing the quantity of Coal forwarded from the Frostburg, Piedmont, and Fairmount Regions, in each Month of 1854.

1854	FROSTBURG REGION.													PIEDMONT REGION.							FAIRMOUNT REGION	AGGREGATE
	C. C. & I. C.			Frostburg Coal Co.			Borden Mining Co.			Allegany Mining Co.			Parker V. Coal Co.	George's Creek Co.	Swanton	Caledonia	Jackson	Phoenix	Llangollen	New Creek		
Month	R. R.	Canal	Total	R. R.	Canal	Total	R. R.	Canal	Total	R. R.	Canal	Total	Rail Road	R. R.	R. R.	R. R.	R. R.	R. R.	R. R.	R. R.	Rail Road	Tons
Jan.	6,715		6,715	1,848		1,848	1,182		1,182	1,258		1,258		1,605	961	912	1,080	301		For the Year	From Jan. 1st to 30th Sept. 1854	15,868
Feb.	2,771		2,771											577	162	518	170					4,198
March	1,918		1,918											1,858	906	28	465	392				4,868
April	11,932	8,536	20,468	3,716	3,378	7,094	4,738	3,080	7,818	3,248	1,752	5,000	28	3,783	2,541	3,586	2,908	395				58,476
May	17,188	15,650	32,838	6,430	3,856	10,286	6,420	4,340	10,760	5,552	2,486	8,038	660	5,655	5,223	5,651	5,178	87				84,816
June	19,264	14,955	34,219	5,934	4,021	9,955	5,976	4,083	10,059	5,977	2,777	8,754		5,124	5,858	4,427	2,085	258				80,299
July	19,946	13,080	33,026	5,392	2,834	8,226	5,584	3,762	9,346	5,903	1,976	7,879		5,491	5,891	4,226		1,085				74,670
Aug.	25,488	9,669	35,157	5,490	2,486	7,976	6,983	2,461	9,444	6,319	1,901	8,220		5,886	5,877	1,188		1,713				75,461
Sept.	20,463	2,889	23,352	6,921	1,101	8,022	6,386	1,189	7,575	4,913	256	5,169		6,684	6,177	238		1,903	For the Year		37,437	96,509
Oct.	20,189	8,670	28,859	7,158	2,302	9,460	6,432	1,158	7,590	5,270	1,720	6,990		8,026	6,182	1,621		1,511			8,580	78,819
Nov.	18,780	16,586	35,366	5,733	4,088	9,821	6,292	3,388	9,680	5,021	2,837	7,858		7,392	5,498	2,741					10,470	88,890
Dec.	8,981	2,106	11,087	2,785	298	3,083	2,326	164	2,490	1,528	87	1,615		5,290	4,849	752			8,155	22,708	5,676	65,185
	173,580	92,141	265,721	50,957	24,314	75,271	52,319	23,625	75,944	44,989	15,792	60,781	688	57 381	47,920	25,888	11,881	7,490	8,155	22,708	62,163*	721,871

RECAPITULATION

FROSTBURG REGION,	by Rail Road	322,533	
" "	by Canal	155,872	478,405
PIEDMONT "	by Rail Road		181,303
FAIRMOUNT "	by Rail Road		62,163
	Aggregate		721,871 Tons.

* Of this quantity 8,921 tons were used locally by the B. & O. R. R. in their locomotives.

C. SLACK, *Supt.*
C. & P. R. R. Co.

Estimate of the amount of Coal that will be required to supply the Eastern or Atlantic coal trade for the next ten years, 1855–1864 *inclusive, on the supposition that the consumption will increase in the same ratio that it has for the years* 1850, 1851, 1852, 1853, 1854, *and that corresponding facilities for transportation are provided.*

Estimate of the Semi-Bituminous Coal of the Cumberland Basin.

The average increase per cent, for the years 1850, 1851, 1852, 1853, 1854, has been $38\frac{7}{10}$ per cent., and the actual delivery at market, according to the table of Mr. Slack, was, for 1854, 721,871 tons.

	Tons.		Increase.		Tons.		
1854,	721,871	at 38 per cent.	274,310	requires	996,181	for	1855
1855,	996,181	"	378,548	"	1,374,729	"	1856
1856,	1,374,729	"	522,397	"	1,897,126	"	1857
1857,	1,897,126	"	720,907	"	2,618,033	"	1858
1858,	2,618,033	"	994,852	"	3,612,885	"	1859
1859,	3,612,885	"	1,372,896	"	4,985,781	"	1860
1860,	4,985,781	"	1,894,596	"	6,880,377	"	1861
1861,	6,880,377	"	2,604,543	"	9,484,920	"	1862
1862,	9,484,920	"	3,604,269	"	13,089,189	"	1863
1863,	13,089,189	"	4,973,891	"	18,063,080	"	1864

Estimate for the Pennsylvania Coals.

The average increase per cent. for 1850, 1851, 1852, 1853, 1854, has been $13\frac{29}{100}$ per cent., and the actual delivery at tide water for 1854 was 5,932,809 tons.

	Tons.		Increase.		Tons.		
1854,	5,932,809	at 13 per cent,	771,265	requires	6,704,074	for	1855
1855,	6,704,879	"	871,529	"	7,575,603	"	1856
1856,	7,575,603	"	984,828	"	8,560,431	"	1857
1857,	8,560,431	"	1,112,856	"	9,673,287	"	1858
1858,	9,673,287	"	1,257,527	"	10,930,814	"	1859
1859,	10,930,814	"	1,421,005	"	12,351,819	"	1860
1860,	12,351,819	"	1,605,636	"	13,956,455	"	1861
1861,	13,956,455	"	1,814,339	"	15,770,794	"	1862
1862,	15,770,794	"	2,050,203	"	17,820,997	"	1863
1863,	17,820,997	"	2,316,729	"	20,137,726	"	1864

(To be continued.)

IRON AND ZINC.

ON AN IMPROVED CONSTRUCTION OF MOULDS FOR CASTING METALS.*

The subject of this paper is the invention of Mr. John Jobson, of Derby, and may perhaps be considered as one of the results of the difficulty experienced in the labor market. This invention consists of a mode of constructing the moulds for metal castings, by means of which the process of moulding is simplified, and an important economy effected in the cost and time of moulding; also the accuracy and perfection of the moulds is increased, so that the castings produced have less "fin" or other irregularities than usual, and greater uniformity is insured in running the metal, than in the ordinary method of moulding, reducing the proportion of "wasters."

The advantages of the new plan are most felt in the cases where a large number of castings have to be made from the same pattern; also where the more intricate form of the pattern (as in foliage or ornamental castings) makes it difficult to draw from the sand in the ordinary process of moulding, and the irregular surface of the "parting" or separation between the moulds increases the difficulty of making a clean casting, free from "fin," and also involving considerable time and skilful labor, which has to be repeated for every casting.

In the process of moulding (the subject of the present paper), after the pattern has been first partially imbedded in the sand of the bottom box (as is in ordinary moulding), and the parting surface accurately formed, the top box is then placed on, and is filled with plaster of Paris, or other similar material, to which the pattern itself adheres. When the plaster is set, the boxes are turned over, the sand is carefully taken out of the bottom box, and a similar process repeated with it,—using clay-wash to prevent the two plaster surfaces from adhering. This forms a corresponding plaster mould of lower portion of the pattern. These two plaster moulds may be called the "waste blocks," as they are not used in producing the moulds for casting, but are subsequently destroyed.

Reversed moulds, in plaster, are now made from these waste blocks (the pattern being first removed), by placing upon the bottom box a second top box, an exact duplicate of the former top box, and filling it up with plaster (having used clay-wash as before), and doing the same with the other box. Reversed moulds are thus obtained, from which the final sand moulds for casting are made, by using them as "ramming-blocks," upon which the sand forming the mould is rammed, by placing a third duplicate top box upon the ramming-block, and a corresponding bottom box upon the ramming-block.

The requisite "gits," "runners," and risers," are formed previously in the original sand mould, and are consequently represented in the ramming-blocks by corresponding projections or ribs upon the parting face of the one, and hollows in the other (which are then stopped up with plaster), and these are properly repeated in the final sand moulds: these last, therefore, when put together, form a complete mould for casting, just like an ordinary sand mould, but having some important advantages.

Any number of succeeding moulds can be made from the original ramming blocks by the simple process of ramming, without any handling of the pattern or turning over the boxes; both top and bottom moulds being rammed independently, and at the same time, if desired. The parting being once accurately formed in the original mould, all the succeeding ones are necessarily correct, without any further care being required; and by carefully trimming the original, and slightly paring down the inner edges of the parting faces, if requisite, the faces of the final sand moulds have a corresponding fulness, and are readily adjusted, after the first trial, to fit so closely together, that practically no fin is left on the castings, as shown by the specimens before the meeting, which are all of them just in the state in which they left the sand, never having been dressed or trimmed. Also, the labor of forming the

* From Lond. Journ. and Rep. Sci., Nov., 1854.

gits and runners afresh for each casting mould is avoided, by having them completely imprinted upon each mould in the process of ramming; and by this means all the risk is avoided of imperfect castings arising from want of uniform care or judgment in the formation of the gits, &c.' by the moulder in the ordinary process. This is the more important in the case of difficult castings, where several trials may be required before the best mode of running the metal is ascertained, so as to insure sound, good castings; and by this process the exact repetition of the same plan is insured, without requiring any further attention from the moulder.

A small hollow is imprinted in the ramming-block for the top box, into which the plug for forming the git is rested whilst the box is rammed; and by this means the git is insured being formed in the right place, without any care on the part of the moulder.

When the pattern is long and very thin and intricate (as in the case of an ornamental fender front), where the general surface is also curved or winding, the difficulty of picking out the pattern from the mould is so great as to require the most skilful workmen; and the length of time required for repairing the injuries of the mould, causes about eight sets of fender castings per day to be the general limit to the number that can be moulded by one man and a boy. But however difficult the pattern may be to mould in the ordinary way (if it is arranged to "draw" properly from the mould), with the new process the labor is very little greater than with an easy pattern, and the saving of time is so great that as many as 30 per day are moulded on the average by one laborer and boy.

When the pattern is slender and long, it is liable to be broken in the frequent handling to which it is subjected in the ordinary process of moulding, and the expense and delay caused by breakage of patterns is of serious consequence in light ornamental work; but in the new plan this is entirely avoided, as the pattern is never handled except in the first process of moulding, to form the ramming-blocks.

When the face of the castings is required to be particularly well finished (as in the case of ornamental work) a brass or other metal pattern is made, and is dressed up and finished to the degree that may be desired in the castings, and any chasing or other additional ornament put upon it; then, after forming the ramming-block for the bottom box by a plaster cast from the pattern in the manner before described, the pattern itself is made to form the permanent face of the ramming-block for the top box, by leaving it in the mould when the plaster is poured in; so that the plaster forms merely the parting face, and a solid back to the pattern. In this case the iron pattern is secured to the cross bars of the box by several small bolts screwed up to plates at the back of the box; so that, when the plaster is poured in, filling up the whole vacant space of the box, and setting solid around these bolts and over these nuts, the iron pattern becomes so firmly secured in the box, that no ramming or moving to which it is afterwards subjected will loosen it.

In this plan the mould for the face of every casting is formed from the original metal pattern, and the pattern itself is firmly and permanently secured in the plaster bed; so that, however thin and delicate it may be, there is no risk of injury to the pattern, in moulding any number of castings;—as many as 3,000 have been cast without injury from a slender ornamental pattern.

In forming the ramming-blocks, common plaster of Paris is generally employed, as the most convenient and economical material; and this is found to be sufficiently durable for general work. The blows of the rammer are deadened by the sand in the box, and do not fall directly upon the plaster block,—so that there is no risk of injury with ordinary care in ramming. As many as 4000 castings have been moulded from one pair of plaster blocks; but when a greater number of castings is required from one pattern, or when the size or nature of the mould renders a harder face advisable, a metal face is employed for the ramming-block of the bottom box, or for the parting surface of one or both blocks. This is formed simply by running into the mould when prepared for the plaster, a small portion of metal, consisting of zinc, hardened

with about $\frac{1}{12}$th part of tin; sufficient metal being used to form a strong plate for the surface of the ramming-block, and the rest of the space at the back filled with the plaster as usual. In practice it is more convenient generally to reverse the mode of running this metal for the face of the mould, by first ramming the box, when prepared for the plaster, full of sand, then lifting it off, and paring off the surface of the sand wherever the metal is wanted to such depth (about $\frac{3}{8}$ of an inch) as may be desired for the metal; and when the box is replaced in its former position, the metal is run in, filling up those spaces where the sand has been cut away. The sand in the upper box at the back of the metal face is then all removed, without moving the box (part at a time if requisite), and plaster poured in above to fill up the box and make a solid back as before.

The metal face is firmly secured to the plaster back by several small dove-tail blocks cast upon the back of the metal, by cutting out corresponding holes in the sand mould before the metal is run in. Various modifications of this plan of construction are employed, according to circumstances, for economy or convenience; and sometimes the face of the ramming-block is partially covered by separate pieces of metal; but in every case, the entire face of the two ramming-blocks forms a perfect counterpart of the intended casting (half being represented upon each,) surrounded by parting faces which exactly fit one another, because the one has been moulded from the other.

Where the pattern is long, and a metal face is employed, a narrow division is made, subdividing the metal face into two or more lengths, to allow for the shrinking of the metal forming the face,—the effect of which is then found to be imperceptible. The plaster ramming-blocks are varnished when dried, to preserve them from damp; and, in moulding from them, the faces of the blocks are dusted with rosin, to prevent adhesion of the sand.

The new process of producing the blocks, though somewhat complicated in description, involves practically but little increase of work over the process of moulding required for the first casting produced by the ordinary method; but every subsequent casting, instead of requiring a repetition of the whole process of the first moulding, as in the ordinary method, is moulded by simply ramming the boxes upon their respective blocks. The ordinary "odd side" boxes are used for this purpose—all that is requisite being that every top box fits steadily and securely upon every bottom box, so that they may be interchanged in the process of forming the ramming-blocks, without the disturbance of the relative position of the pattern. An improved form of the steady pins for connecting the top and bottom boxes has been adopted. Instead of four or more round pins fixed on the bottom box, and fitting into corresponding holes in lugs cast upon the top box, vertical angular studs are cast on each bottom box, and fit against corresponding projections on the edge of the top box. The only fitting required in making the boxes is to file the touching angles of the pins, so as to fit one standard top box; the projections on the top boxes being all fitted to one standard bottom box.

It has to be noticed, that in the ordinary plan of moulding, and by the "odd side" and "plate" methods, one side of a pattern is not available while the other is in use. By the new process, each pattern is equal to two, as it will be evident that both blocks may be worked from at the same time.

Mr. Jobson exhibited a number of specimens of castings rough from the mould, to show the unusually small amount of fin upon them, and the good quality of the castings obtained by the new process of moulding. Also several of the plaster ramming-blocks were exhibited of the different kinds, and a pair shown in operation, showing the quickness of the process of moulding from them, and the perfection of the sand moulds obtained.

The Chairman thought the process was certainly very efficient in insuring expedition and accuracy, and the moulding was remarkably perfect; there must be an important economy both in the cost of moulding and in the cost of dressing the castings, which were turned out remarkably clean and free from fin.

Mr. Jobson said that in the ornamental castings the dressing formerly cost as much as £10 per ton from the fin left in the process of moulding; but this expense was now mostly saved, as there was practically no fin left with the new plan. The specimens exhibited showed the ordinary average work produced; and the castings were just in the state in which they left the mould, not having had any trimming or dressing. For particularly fine work a sulphur face was used for the ramming-blocks instead of plaster; a small thickness of sulphur being first run on to form the face of the block, like the metal facing used in those blocks from which a very large number of moulds was required to be rammed.

In answer to an inquiry, he stated that the largest size of casting at present moulded by the new process was about 8 feet 6 inches square, and 8 ft. by 1 ft.. With large castings there was seldom perhaps a case of a sufficient quantity from one pattern, or it might be advantageous to apply the plan.—*Proceedings of the Institution of Mechanical Engineers, Birmingham.*

QUARRIES AND CLAYS.

HALL'S FIRE BRICK.

There is, perhaps, no article of consumption used by the manufacturers of iron, in which they are more interested, than a supply of good fire-brick.

Until recently, a large proportion of the fire-brick used, has been imported from Europe, but, within a few years, several establishments for the manufacture of this article have been erected in the United States, and among those producing the best brick made, are those at Perth Amboy, in the State of New Jersey; the largest of which, and the most recently established, is that of A. Hall & Sons, whose works have been erected at a large outlay of capital, with a view to making the very best quality of brick, at the cheapest rate, and in large quantities, with the intention of always having a supply on hand.

From our knowledge of this establishment we believe it is the largest and most perfect of the kind in the United States. We learn from the head of the firm, that 1,250,000 bricks were manufactured there in seven months, the past season; 750,000 of which have been shipped to market, and that 500,000 are now ready to ship to order; that of this large quantity in the hands of customers of the last season's manufacture, not one word of complaint has been heard against the quality of the brick. On the contrary, many of the consumers have voluntarily spoken of their superior quality for use in rolling-mills, and for the manufacture of steel for forges, &c., and among these are those who have had much experience in the use of a great variety of bricks, of both foreign and American manufacture.

Among these are Mr. J. D. Weeks, of the Stillwater Iron Company, who says: "We have never been as well served with brick as by you." And Messrs. Wm. E. Coffin & Co., who use them altogether in their Rolling Mill, at Pembroke, say: "It is our belief now that there are no better American bricks made." Mr. C. D. Delaney, of the Niagara Steam Forge Company (Buffalo), says: "Our superintendent says they are the best brick we have used."

Samples may be seen at this office, to which the manufacturers invite the most severe test.

MISCELLANIES.

RENSSELAER POLYTECHNIC INSTITUTE.

We are indebted to the officers of this Institute, located in Troy, for a copy of their Register for the present year. The establishment of this Institution is thus described:—

The Rensselaer Polytechnic Institute was founded in 1825, by the late Hon. Stephen Van Rensselaer, as a school of theoretical and practical science. In 1826 it received from the Legislature of the State of New York, its act of incorporation, with those chartered authorities and privileges, usually conveyed to the higher institutions of the State.

In 1849, the Institute was wholly re-organized, and, in its new form, upon the basis of a general Polytechnic Institute. Among the changes then introduced, were, a material enlargement of its course of study, with a proportionate increase of the time allotted to it, and a correspondingly more elevated, and more rigidly held, standard of requirements for the admission of candidates to scholastic honors.

Since its foundation, the Institute has sent forth a considerable number of Graduates, who,—as professors and teachers of the mathematical and physical sciences, as practical chemists and geologists, and as engineers in the various departments of constructive and topographical art,—have contributed to the increase and diffusion of science, as well as to its applications to the business pursuits of life, with a success, to which it is believed, the Institute may refer with becoming confidence and just pride.

The Institute is under the control of a President and Vice President and 16 trustees. The General Director of the Academic department is B. Franklin Greene, Esq. The faculty of the Institute comprises distinct professorships upon the following subjects:—

Philosophy of the Mind.
Mechanics, Machines and Construction.
Mathematics, Practical Astronomy and Geodesy.
Physical Geography and Natural History applied to the Arts.
Practical Geology and Mining.
English Composition and Criticism.
Theoretical, Practical and Technical Chemistry.
Graphics.
French and German Languages.

The course of Instruction, as exhibited in the Register, comprises all the mental and practical operations involved in the subjects taught by the Faculty. The course is based upon an extended system of *Mathematics*, comprising their means of mental discipline with their practical applications to general science and the arts.

The duration of the course is three years, divided in semi-annual sessions of twenty weeks each. The Institute bills are $85 per session, payable in advance. The entire annual expenses, necessary for the tuition and support of the student are from $196 to to $268.

The Register for 1854 contains the names of 104 students, now connected with the Institute, viz.:

Students of the third year	8
" " second "	19
" " first "	45
" " Preparatory Class . . .	32
Total	104

THE EMERY TRADE.

A company has recently been formed for the purpose of securing the exclusive supply of the mineral known as the emery stone. It may not be

generally known, that although emery has been sought for in all parts of the world, it has only been found in two places—in the island of Naxos, in Greece, and at a few spots in Turkey. The annual production is at present limited to 2,000 tons of Naxos stone, and 1,600 tons of Turkish. This material is largely used by the manufacturers of machinery, and all iron and metal workers, as well as by lapidaries; but it is especially required in the grinding and polishing of plate-glass; and from the enormous increase in the consumption of the latter article, a corresponding demand for emery must be the result. But, hitherto, the adulteration of this mineral has been carried on to such a great extent, materially delaying the operations of the manufacturers and the artisan, that we are certain the obtaining it in its pure state will be hailed as a great boon. The directors of the present company are composed of gentlemen not only of wealth, but well known in the commercial world—Messrs. John Taylor and Sons being the managers, which we may consider will be a guarantee for fulfilling the statements they have put forth. Mr. Abbott is the present holder of the exclusive privileges, and has a Turkish firman for an unlimited time, and a contract with the Greek government for 10 years. The company have made a satisfactory arrangement with this gentleman, and by the application of an ample capital there is no doubt of its becoming one of the most profitable speculations of the day, as, in fact, they will have the exclusive supply, not only to Great Britain, France, Belgium, Holland, and the United States, but for the whole world; and even should they fix the price rather high, if they perform their agreement to sell it unadulterated, the consumers will be more than compensated by the time saved in the various operations in which it is used. The company propose to sell the stone either in its raw or manufactured state, and, with a view of commencing immediately, they intend making an arrangement with the Colonial Gold Company for the use of their works and machinery at Rotherhithe. The company is constituted under the Joint-Stock Registration Act, the capital being fixed at 120,000*l.*, in 12,000 shares of 10*l.* each.—*London Journal.*

NEW SYSTEM OF GAS-BURNING.

M. Ador has at length succeeded in applying his system of gas-lighting on the largest possible scale. In the immense *Cafe Estaminet de Paris*, he has established a great number of apparatus, furnishing together nearly six hundred candle-burners. The Ador apparatus consists essentially of a tube on which are screwed two bulbs, the one above, which is surrounded by the flame, and into which the gas passes from the meter, the other below, supplied by any hydro-carbon (liquid), the surface of which the heated gas licks, and then passes out by small tubes arranged at the summit of this second ball. By this arrangement, the gas is under conditions very different from those in which ordinary burners place it. For, first, the rise of temperature which it undergoes dilates it, causes it to occupy a greater volume, and consequently brings it into contact with a greater quantity of air; the combustion is thus more perfect, and there is no longer any smoke. And, secondly, the contact with the warm hydro-carbon supersaturates the gas with carbon, or solid particles in a state of extraordinary division, and increases in a considerable proportion the brilliancy of the flame, a brilliancy proportioned to the number of solid particles in ignition. This last effect is so certain and so excellent, that when applied to pure hydrogen extracted from water, a gas which in burning gives out a great deal of heat but scarcely any light, it transforms it into an excellent lighting gas. The final result of the two modifications which common gas thus undergoes, is an economy of at least fifty per cent; in fact it is established by numerous and positive experiments, that the elevation of temperature alone diminishes by one third the quantity of gas consumed for equal light, and the effect of carburation is almost equally great.—*Cosmos*, vol. v. p. 257.

Improved System of Boring.

A very important paper was read before the Institution of Mechanical Engineers, at Birmingham, by Mr. Samuel H. Blackwell, of Dudley, "On Kind's improved System of Boring." Although that system has been extensively and successfully employed upon the Continent, it is strange that it has not yet been introduced or adopted in England.

The defects of the present English system arise from the permanent attachment of the boring chisel to the rods employed to lift and lower it, the blow not being given simply by the chisel itself, but by the entire length of the rods and chisel, forming together one single tool. When great depths are attained, the vibration communicated to the rods through their entire length by their fall, and the percussion of the chisel, require corresponding strength and weight, and the space through which the rods are liable to fall is necessarily very limited. A small chisel is, therefore, always used; the bore-hole is correspondingly small, creating much friction against the sides, thus rendering the indications of the measures passed through uncertain, from there being more or less ground for the action of the chisel.

The improved system proposed to be introduced remedies all these defects; the chisel is free, attached to the rods simply whilst being lifted; the lifting can be effected to any height required, and when so lifted, the chisel is detached from the rods, and falls freely by itself. The rods may be made light and the chisel heavy; and as they merely follow it, pick it up, and lift it again for another fall, no vibration is communicated to the rods by the operation. As the boring-tool can be made to fall through any space, the impetus obtained gives corresponding rapidity to the work performed; large bore-holes may be thus made, and cores of six or ten inches diameter taken out, showing the precise character of the beds which had been passed through, and their exact stratification. Specimens were exhibited to the meeting, of solid cores cut out and raised by the apparatus, one a cylindrical piece of salt rock, 5½ inches diameter, and 12 inches long, from the Montmorel salt mines, in the south of France, bored at about 200 yards in depth, broken off square at the ends. The other specimen was hard shale rock from the coal measures, 7½ inches diameter, and 12 in length, with the ends sloped off at an angle of about 45°. A general opinion pervaded those present that specimens so regular in form showed great perfection in the action of the apparatus, that the operation must be very complete, and tend to prevent useless outlay, by affording information as to the actual dip and formation of the strata.

At the lower part of the rods there is a bar or slide, attached at its upper end to a piston, and at its lower edge to a wedge or ring, which has the power of a slight upward and downward movement, so as to open or close as it ascends and descends, the fangs working upon central pivots. When the fangs are closed by the downward pressure of the wedge and ring, they firmly clasp the head of the boring tool; but when the fangs are opened by the upward pressure of the wedge and the ring, the tool is loosened from the fangs, and entirely detached by its own weight. The opening and closing of the fangs are effected by the action of water in the bore-hole, pressing on the piston either at the upper or lower surface. Chisels of any required form may be screwed on, either to cut away the whole material of the borehole, or to leave a solid central core; when the latter is required, curved teeth are used, which groove themselves into the core, and then by a sudden jerk, the core is detached, and brought carefully to the surface.

Mr. Blackwell then exhibited a tabular abstract of registers kept of borings on Kind's system, showing the depth reached in France, in one instance 855 yards, at a cost of 1*l.* 0s. 11d., which appears to be near the ordinary average. In the course of the discussion it was observed that the boring tool in common use was better in some respects in soft strata, when samples were not desired.

Mr. Siemens observed that he was acquainted with the invention, and had

seen the apparatus at work in France for salt-works, that the process was very successful, and the work was accomplished with great precision. This mode was considerably superior in quickness and economy to the ordinary method of boring, and the average cost of deep borings was not more than one half. It was further stated that the rods were effectually prevented from twisting by passing through a fixed guide at top, and that there was often found sufficient water rising in the hole to wash out the crushed material, otherwise water was passed into the hole in a stream sufficient for that purpose.

French Weights Reduced to English.

As French weights are now used in many scientific works, which are translated and reprinted in our country, we present the following table, so that all our readers may understand their relation to that of the English standard.

Milligramme	·0154 grs.
Centigramme	·1544 "
Decigramme	1·5414 "
Gramme	15·4440 "
Decagramme	154·4402 "
Hecatogramme	1544·4023 "
Chiliogramme (Kilogram.)	15444·0234 "
Myriogramme	154440·2344 "

A Decagramme is 6 dwts. 10·44 gr. tr.; or 5·65 dr. avoir.
A Hecatogramme is 3 oz. 8·5 dr. avoir.
A Chiliogramme is 2 lbs. 3oz. 5 dr. avoir.
A Myriogramme is 22 lbs. 1·15 oz. avoir.
100 Myriogrammes are 1 tun, wanting 32.8 lbs.
There are 7000 grains in 1lb. avoir.

Salt Factories in Ohio.—Pomeroy.

It is known, that in the South-eastern part of Ohio, salt water is found abundantly; but heretofore the water has been found too weak to compete successfully, for more than local use, with the salines of Kanawha, of Conemaugh, or of Syracuse. Hence the quantity manufactured in Ohio has been comparatively small. But of late, the tables are likely to be turned. The difficulty in the old wells was *in not boring deep enough*. The real saliferous rock lies, in that region, about 1,000 feet in depth. The old wells were generally dug about 400 or 500 feet in depth. They got water, but it was not the original springs, but diluted quality. Recently, however, boring has been carried to the saltbearing rock, and salt water in great abundance is obtained, and of strength sufficient to compete with other Western salines.

The most successful experiment of this sort has been made at Pomeroy, in the vicinity of the Coal Mines. Till within the last few years, no salt wells of any consequence existed near there except one or two on Leading Creek. Some years ago, an attempt was made in boring deeper, at Pomeroy; but it was dropped before it was completed: about three years since the enterprise was resumed, and has been attended with extraordinary success. From the first well, there arose a powerful jet of water, with an abundance of carburetted hydrogen gas—which was economically used as fuel to the furnace. Since that time, other furnaces have been erected, and others are yet projected: so that this branch of manufacturing promises to be carried on there very extensively. The following is the statistical account of these salt works at the present time.

In the vicinity of Pomeroy, and on the river, there are now *four* salt companies manufacturing an average of 250 barrels, or 1,750 bushels of steam salt per day.

At West Columbia, on the opposite side of the river, and four miles below Pomeroy, there are *two* furnaces, making about 60 barrels, 420 bushels of salt per day.

One furnace in Pomeroy, just finished, will make about 40 barrels, or 280 bushels per day.

One furnace, at the mouth of Leading, four miles below Pomeroy; and *one* at Syracuse, four miles above, will probably be in blast by the 1st of January, 1856.

These furnaces will in all make about 3,000 bushels of salt per day, or allowing for 300 working days—900,000 bushels of salt per annum. There is no reason to doubt, that this manufacture may be continued almost indefinitely,—and Pomeroy and its vicinity, will probably become, eventually, the scene of an activity and a business in this branch of trade equal to that at Syracuse, (N. Y.)

The depth of the Pomeroy Wells, on the river, varies from 1,020 to 1,200 feet. The water stands at from 9° to 10°. The quality of the salt is equal to that made on the Kanawha. Two of the above wells are supplied with gas, and these are the property of the Pomeroy Company.

From a well at Coalport, there is, at times, a copious flow of petroleum. During the first year, the Company owning this well sold about $900 worth. Most of this oil was sold at twenty-five cents per gallon to Bragg & Co., of St. Louis, and made into the celebrated *Mustang Liniment.*

Excluding the two wells on the Virginia side, those on the Ohio side will make now 750,000 bushels of salt per annum,—which is worth in market about $200,000. The salt manufactured at that place, has therefore already arrived at importance.

In 1850, the total product of salt in Ohio was 550,350 bushels. As there was, then, none made at Pomeroy of any consequence, we may add the total amount to be produced in 1855, at that place, to the amount stated in the census for 1850; so that Ohio will produce in 1855, at least 1,300,000 bushels of salt exceeding the product of any State, except those of New York and Virginia. We should not be surprised to find Ohio in a short time producing salt to an amount greater than that of any State.

In some places, such as Jackson and Vinton counties, salt was made in the early settlement of the State, and abandoned on account of the weakness of the water. As the salt rock was not reached then, it is probable that wells bored to the same depth as at Pomeroy will produce water equally strong. It is at least well worth trying the experiment.—*Railroad Record.*

NEW METALS FOR MACHINERY.

Mr. J. P. Kingston, Lewisham-road, Kent, Eng., has patented the combination of tin, copper, and mercury, and using the same as bearings, or linings of bearings, and for packings for machinery. In carrying-out this invention, the patentee melts (say) about 9 lbs. of copper, and adds thereto 24 lbs. of tin. This combination he allows to cool, and again melts it, and then adds 108 lbs. of tin; and when the tin is melted, he adds 9 lbs. of mercury, and then allows the whole to cool. The patentee remarks, that he does not confine himself to the precise quantities of the metals above given, but believes them to produce the best compound for the purposes of the invention. The compound metal thus produced, is to be made into bearings, if for light machinery, by forming it, when re-melted, into moulds of the proper forms; and when making packings of machinery, the melted metal is run into the spaces to be packed, as has heretofore been done with other soft metal, taking care that the surfaces to which the packing is not desired to adhere are covered with smoke or other proper material, as is well understood. When lining bearings, the surfaces of the boxes or bearings (where the lining is to adhere) are first to be tinned, and the melted metal is then run; cores and moulds being used when necessary, as has heretofore been practised. The patentee claims the combining mercury with tin and copper in the manufacture of bearings and packings for machinery.

THE

MINING MAGAZINE.

EDITED AND CONDUCTED BY

WILLIAM J. TENNEY.

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THE

MINING MAGAZINE:

DEVOTED TO

Mines, Mining Operations, Metallurgy, &c. &c.

VOL. IV.—APRIL, 1855.—No. IV.

ART. I.—A REPORT ON THE ECONOMIC VALUE OF THE SEMI-BITUMINOUS COAL OF THE CUMBERLAND COAL BASIN, &c.*—By ROBERT G. RANKIN.

The grate bars should at all times be well and uniformly covered. If not well and equally covered, the air will enter in irregular and rapid streams or masses through the uncovered parts, and at the very time when it should be *there* most restricted. Such a state of things bids defiance to all control, and yet on the control of the supply of air depends perfect combustion; and until the supply of fuel on the bars is regulated, it will be impossible to regulate the supply of air. When a charge of coal is nearly exhausted, it begins to burn in holes, admitting more air through them, and increases the combustion around the hole. By levelling the coal and covering the holes, and thereby and continuously diffusing the coal, the temperature of the flues will be immediately raised, and less dense smoke will be formed.

In regard to the chamber part of the furnace in marine and cylindrical boilers, it may be safely assumed that they are invariably made too small. The insufficient capacity of these chambers is best appreciated, when it is remembered that in them the gases are generated, their constituents separated, each brought into contact with the oxygen of the air, and thus combustion effected. The actual and profitable experiments of Mr. Williams have demonstrated the fallacy of the idea, that the nearer the body to be heated was brought to the source of heat, the greater would be the quantity received. Absolute contact with flame should be avoided, when the object is to *obtain all* the heat which could be produced by the combustion of the entire mass of the constituents of the fuel.

Ure illustrates this position by holding a copper or porcelain capsule containing water, over the flame of a lamp or candle, a little above its apex, when the flame will suffer no abatement of brightness, but will keep the water boiling. If the capsule be

* Continued from Vol. IV., page 158.

lowered into the middle of the flame, it will immediately lose its brightness, becoming dull and smoky, covering the bottom of the capsule with soot; and the water, although surrounded with flame, ceases to boil, owing to imperfect combustion.

It follows, that air or its oxygen is as essential for the combustion of the gaseous part of the coal, as for the solid coal itself, to produce the true effective power of the coal.

The question naturally arises, How is this air or oxygen to be introduced to these gaseous elements? The following report to the Directors of the Dublin Steam Packet Company answers the question:—

1st. That in the combustion of coals, a large quantity of gaseous and inflammable material is given out, which in furnaces of the ordinary construction is in a great measure lost for heating purposes, and gives rise to the great body of smoke, which in manufacturing towns produces much inconvenience.

2d. That the proportion which the gaseous and volatile portion of the fuel bears to that which is fixed and capable of complete combustion on a common furnace grate, may be considered as *one* fourth, in the case of ordinary coal.

3d. That the air for the combustion of this gaseous combustible material, cannot with advantage be introduced either through interstices of the fire bars, or the door by opening it. In the former case, the air is deprived of its oxygen by passing through solid fuel, and then only helps to carry off the combustible gases before they can be burned; and in the latter case, the air which would enter by reason of its proportionate mass would produce a cooling influence, and cannot conveniently be mixed so as to support the combustion of the gases.

4th. That the combustion of the gaseous materials of the fuel is best accomplished *by introducing, through a number of thin* or small orifices, *the necessary supply of air*, so that it may enter in a divided form, and rapidly mix with the heated gases, in such proportions as to effect their complete combustion.

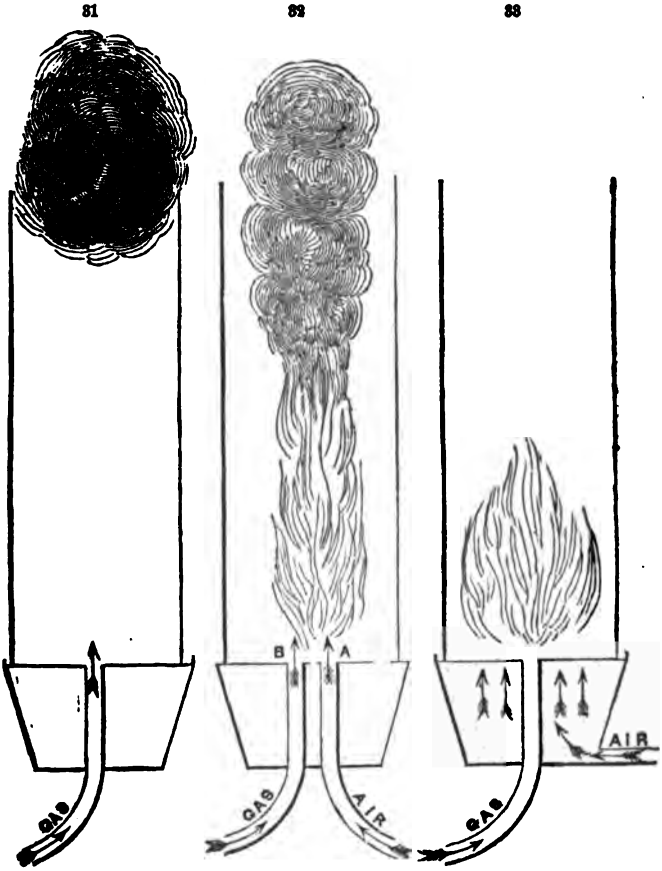
5th. That in burning *coke*, or when coal has been burned down to a *clear*, *red fire*, although the combustion on the grate may appear perfect, and little or no flame may be produced, and no smoke whatever made, *there may yet be a great amount of useful heat lost*, owing to the formation of carbonic oxide, which, not finding a fresh supply of air *at the proper place*, necessarily passes off unburned.

The following experiments and diagram, taken from Mr. Williams' work, illustrates the preceding positions most forcibly. Figs. 31, 32, 33, represent each a tin apparatus, with its glass chimney, similar to the ordinary Argand burner; the gas is admitted the same way in all three; the difference to be noted is, in the manner in which the air is admitted. In all these cases the quantity of both gas and air was the same.

In fig. 31, no air is admitted from below, and the gas, consequently, does not meet with any until it reaches the top of the glass, where it is ignited, producing a dark smoky flame.

In fig. 32, air is admitted from below, and rises through the orifice at A, concurrently with the gas at the orifice B. On being ignited, one long flame is produced, of a dark color, and ending in a smoky top.

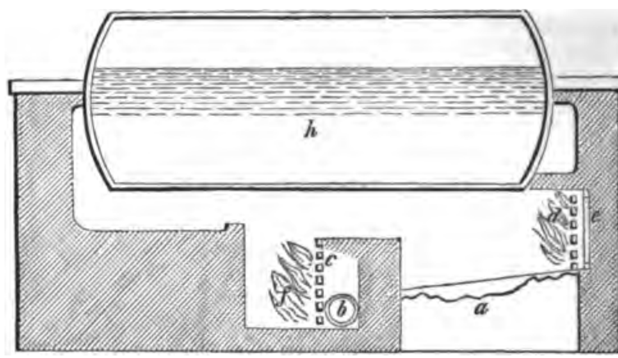
31 32 33



In fig. 33, the air is introduced from below, and into the chamber at *c c*, from which it issues through a perforated plate, like the nose of a watering-pot; thus producing immediate mixture with the gas. On being ignited, a short, clear, and brilliant flame was produced, as in the ordinary Argand gas-burner.

The woodcut, next figure, illustrates Mr. Williams' principles. Here the air is introduced to the bridges and flame beds, *through a great number of small orifices*, connected with a common pipe,

whose area can be increased or diminished, as complete combustion may require. The operation of air thus entering in small jets into the half burned hydro-carburetted gases, *over the fires and in the first flue*, is their perfect oxygenation—the *development of all the heat* which that can produce, and the entire prevention of smoke. In the fig., *a* is the ash pit; *b* is the mouth of a tube or pipe which admits the external air into the chamber or iron box of distribution *c*, placed immediately behind the fire bridge *g*, and before the diffusion or mixing chamber *f*. The front of this box is perforated with holes or oblong spaces for dividing the air; *d* is the fire door, which may have its fire-brick lining also perforated.



The Holyhead mail steam-packet Llewellyn, was constructed to contrast Mr. Williams' principles with the ordinary mode of burning coal. This vessel has two boilers, one before, the other abaft the engine, constructed precisely the same, each having six furnaces, and all furnace fittings alike. For contrast, the fore boiler was allowed to remain as it came from the maker, while the after one had the door frames of each of the furnaces (which are made with box mouth-pieces) perforated with 149 holes, each $\frac{7}{16}$ inch diameter, to admit air. These not being sufficient, the perforated plate behind the bridge was added, in which there were 321 holes—in all 470 holes, the gross area of which is equal to *five square inches for each square foot of fire grate.* The result is, that the *fore* boiler gives out a continuous volume of dense smoke, and the *after* one *none at all.* Nothing can be more demonstrative of a principle than the contrast between the two boilers in this vessel.

It is not expedient in this coal report to discuss the corollaries growing out of this subject, such as, the proportion of internal flue surface; flame and its temperature; circulation of the water; draughts, smoke, &c.; they all are dependent upon the proper combustion of coal.

MODE OF GETTING OUT THE COAL AND DELIVERING TO THE RAILROAD FOR MARKET.

As has been before stated, the coal is interlaminated between the shales and sandstones, and is disposed in strata of different degrees of thickness. Some of these strata are but a few inches thick, and others many feet; the largest seam is about 14 feet average in thickness.

On account of the rapid inclination of the erosions, and the valleys affording the only practicable lines for railroads, all the railroads in this basin must necessarily have high grades, and curvatures of short radii. The railroad of the Cumberland Coal and Iron Company, has grades of 135 feet to the mile. The Mount Savage road rises 1,100 feet in 15 miles, and for the same reasons the access to and from most of the mines to the railroads requires *inclined planes.* These inclines vary in vertical height and length. The mouths of some of the mines are 1,000 feet above the railroad levels, and some of the inclines have grades as high as one foot rise to every three feet in length; the most practicable grade, for ultimate wear and tear, should not exceed one in five to seven. These inclines practically require but three rails instead of four, as generally used, and are self-operating, the loaded cars in descending drawing up the empty ones by means of an endless wire rope, running over suitable drums. At the foot of the inclined planes are the *standages*, or sidings, for receiving the empty cars while waiting for loads, or loaded cars waiting for engines. The small mine cars, as they leave the inclined planes, stop on a platform at the foot of the plane, where they deliver their loads into the market cars at the dump.

The mine cars hold about 1¾ tons, are of narrow gauge, suited to the gauge of the tram roads in the adits, drifts, or approaches into the mines. These drifts are of variable width, contingent upon the size of the vein, and the service required, say from 8 to 9 feet, the height always being sufficient to allow the passage of a mule or horse to draw in or out the mine cars; the grades of these drifts may be, in some of the outerlying mines, such as to allow the mine cars to run out by gravity. The tram roads in the mines are of narrow gauge, and often of flat bar iron, on longitudinal sleepers, and follow the miners as they extend their operations into the bowels of the hills. At suitable distances, ventilating shafts or drifts are constructed, for the proper circulation of pure atmospheric air. The elementary composition of this coal affords entire exemption from the generation of choke-damp, or inflammable gases, and the miner merely requires his ordinary amount of atmospheric air for the prosecution of his labors. Too little attention has heretofore been paid to the process of mining, and in consequence of ignorance and care-

lessness in opening drifts, headings, and chambers: settlement of roofs, creeping of floors, collapses and slides, have caused heavy losses of coal, and involved very serious expenditures for timber props and shield work. From unscientific mining it may not be unsafe to estimate a loss of 30 per cent. of workable coal. For the same reasons, the internal haulage and consequent large amount of *rolling stock* is increased. The great strife appears to be to get out the largest amount of coal within the shortest possible time, without regard to future operations, and the result has been in some instances an abandonment of the old drifts, with loss of road for a new drift, or a large expenditure in clearing the old drift of fallen materials.

The opening of a mine should involve the calculations of years ahead of the period of its opening, for no amount of present benefit from the amount of coal sent to market at the commencement of operations can offset the expenditures, losses, and vexations involved in subsequent periods. It is earnestly recommended, that a thorough topographical and working plan be made before regular mining is commenced; and this can be done with great exactitude, inasmuch as those portions of the coal beds are without faults or dikes, and more than any other coal beds in the world afford certain data for future mining operations and calculations. The spirit of coal stock speculations, and attempts at early realizations, are ruining some of the finest coal lands in the world, for no other known region presents so many facilities for economical mining of coal as this district. From the manner in which the basin has been cut up into peaks, ridges, and hills, the interesting fact is in some instances presented, of a hill or cone like a sugar loaf, with the big 14 foot seam cropping out like a black ring around the whole circumference of the hill, the entire upper mass of the hill cut off from the lower by a sheet or layer of coal, and affording the facility of running the drift entirely through from one side of the hill to the other. (See fig.)

There is a fine example of this configuration in the Ravenscraft property,* covering a portion of such a hill where the drifts will be a mile and a quarter long, and run entirely through the hill, so that a person at one end may see (not over, but through the hill) a person on the other side. Such a conformation affords the most valuable facilities for drainage, ventilation, and delivery, with economical haulage and rolling stock, and with reference to both present and future productions. The cost of mining a ton of coal will be seen in another part of this report. The leading drifts are intersected by the gangways or passages leading to the various chambers or headings where the miners work. An economical railroad track is laid in these drifts and

* Now owned by the Central Coal Mining and Manufacturing Company.

gangways, and is pushed inward as the miner works inward. The number of these drifts, gangways, and headings, determine generally the production of the seam.

OF TIMBER FOR MINING PURPOSES.

One of the great requisites for profitable coal mining is timber for props, shields, roads, buildings, &c. An injudicious system of mining has already deprived some of the coal proprietors of this valuable and necessary material. The Lonaconing property, or Aspinwall purchase, has a large abundance for years to come, and by judicious cutting, the growth of young timber will prove a source of great future value by annual sales off the property. The streams intersecting the region are rapid, fill suddenly, and discharge quickly, and are not reliable for milling purposes. The amount of water shed determines their quantities, modified, of course, by deposition and evaporation; and, whatever may be said to the contrary, it is confidently asserted that no durable and permanent water power exists in the basin: none, at least, which would justify any other expenditure for saw-mills than might be necessary for occasional domestic purposes. Small *portable steam saw-mills* are the most useful timber-cutting machines, and have the fuel always at hand, and on the precise spot wanted, and can, without additional expense, perform all the grinding of breadstuffs for the miners.

The preservation of the timber should be one of the leading objects of the proprietors of these valuable properties.

COKE.

This Maryland coal takes the first rank for conversion into coke. The object of coking coal is to drive off by calcination its bitumine, sulphur, and all volatile, fuliginous and erosive matter, so as to leave the pure carbon. This is done in several ways, by ovens, kilns, and meilers, or mounds covered with the fine coal, and debris of earth. The usual process is to ignite the coals at proper openings in the heap, where it is supplied with atmospheric air; and as the combustion goes on, the gases and volatile matter escaping from below are consumed by the red-hot cinders at top, and as the several layers are ignited, they lose their volatile matter, leaving masses of red-hot coke or carbon. The whole process is regulated, of course, by proper draughts of air, and when the fusion is complete, the whole is cooled down, the coke drawn and sprinkled with water. Most of the waste or fine coal made in and outside the mine's mouth or standages, is made into coke and commands at all times a ready sale, and at a fair price.

The opinion seems to prevail among northern railway operators, that this coal is only fitted for Northern engines when it is coked; but when prejudice gives way to fair investigation and

experiment, *it is confidently believed that the crude Cumberland coal will be found to contain more combustible matter, pound for pound, than the coke.* Cumberland coal coke will weigh about 31.57 pounds to the cubic foot. The loss of weight in coking depends, of course, upon the carefulness of the process, and will vary from 17 to 40 per cent. Its increase in bulk is governed by the same causes, and it will require, upon an average, about 65 cubic feet to make a ton. The experiments in the use of the coke and raw coal for locomotive purposes, and the analysis of the Pennsylvania and Maryland semi-bituminous coals, exhibit the singular fact, that *a ton* of the *Maryland coal* contains more combustible matter than a *ton of the coke* made from it, while the Pennsylvania *coal coke* contains more combustible matter than a *ton* of the *crude coal.*

The demand for this coke is regular, and ahead of the supply, at prices varying from $3 00 to $3 25 per ton, on the ground.

THE MEANS OF TRANSPORTING THE CUMBERLAND COAL TO TIDE WATER, ARE AS FOLLOWS:

1. The Baltimore and Ohio Railroad, 179 miles long from Cumberland to Baltimore. This work was commenced on the 4th July, 1828, finished to Cumberland, November 5, 1842, and cost $10,096,571 to Cumberland. From Cumberland the road extends west to Westernport, 28 miles, on its way to the Ohio River.

2. The Chesapeake and Ohio Canal, 184 miles long from Cumberland to Washington, commenced July 4th, 1828, and finished to Cumberland in 1850, and cost $15,000,000. This canal is admirably constructed for durability, and with a moderate expenditure for improvements, can be made available for the transport of the coal without interruption. For a more particular description of it, see the reports of the chief engineer and H. T. Weld, annexed.

3. From Cumberland, the coal beds are reached by the Baltimore and Ohio Railroad to Westernport, 28 miles, and by the George's Creek Railroad, 8½ miles, to Lonaconing.

From Lonaconing, the road may be continued up George's Creek two miles to the Aspinwall purchase, at a moderate expense, a tram road being already laid.

4. From Cumberland, the Cumberland and Pennsylvania Railroad, formerly called the Mount Savage Railroad, extends 15 miles to Frostburg. This road is one of the best constructed and maintained roads in the country, and its proposed extension of 4½ miles connects it with the Aspinwall purchase, and the very heart and centre of the coal beds, making the distance 19½ miles to Cumberland, against 38 miles from the same point via Westernport, or about 20 cents per ton in the cost of delivering a ton of coal at Cumberland.

5. From Cumberland, the railroad of the Cumberland Coal and Iron Company extends 11 miles to the Eckhart mines, and might be extended at a moderate cost to the other valuable lands on the George's Creek, and to the Aspinwall purchase.

RECAPITULATION OF DISTANCES FROM CUMBERLAND MINES TO NEW YORK BY VARIOUS ROUTES.

	MILES.	MILES.
From Lonaconing by Railroad to Westernport, . .	8½	
" Westernport to Cumberland, ...	28	36½
" Lonaconing via proposed Railroad to Frostburg, .	7½	
" Lonaconing to Aspinwall Mines, . .	2	
" Aspinwall Mines via proposed Railroad to Frostburg, ...	4½	
" Aspinwall Mines via proposed Railroad to Cumberland, ...	19½	
" Aspinwall Mines to Cumberland via Westernport,		38
" " " " Frostburg,		19½
" Frostburg via Mt. Savage to Cumberland, . .	15	
" Cumberland Coal and Iron Co. Railroad to Cumberland, ...	11	
" Cumberland to Baltimore, ...		179
" " Georgetown (Canal), . .		186
By Chesapeake Bay to Canal, ...		54
From Chesapeake and Delaware Canal to Delaware City,		88
" Delaware City to Philadelphia River, . .		41
" Philadelphia to New York by Canal and Bay, .		118

FACILITIES OF THE CHESAPEAKE AND OHIO CANAL AS ONE MEANS OF TRANSPORTING COAL TO MARKET.

COL. C. M. THRUSTON. CUMBERLAND, *April* 2, 1858.

SIR:—In accordance with your request, I have prepared a statement of the capacity of the Chesapeake and Ohio Canal for the transportation of coal to tide-water; and, in so doing, have endeavored to claim for it nothing that I think cannot easily be accomplished; I think that persons conversant with the working of canals will admit that my estimate is a moderate one.

The Chesapeake and Ohio Canal is 185 miles long, extending from Washington City, along the Potomac River, to Cumberland, with a branch about seven miles in length, to Alexandria. It has, at water surface, a width of from 54 to 60 feet; and, at bottom, of 30 feet; with a depth of 6 feet. Its locks have a length of chamber of 100 feet, with a width of 15 feet, capacious enough for boats carrying 130 tons, drawing five feet water; of these, 74 are lift locks, all *single*, with an average lift of eight feet (the greatest lift being ten feet), and all descending towards Washington. The curves in the canal are generally of large radius; the tow-path will, in a short time, be smooth and hard, affording at all seasons a good path for towing-horses.

The arguments usually advanced against the capacity of the

canal for carrying a large quantity of coal are: 1st. That its locks are *single;* 2d. That the tunnel, not having sufficient width for boats to pass each other, will soon limit the transit of boats; 3d. That the supply of water for the upper fifty miles is inadequate, in dry seasons, to supply the leakage and evaporation, and the lockage water necessary for a large trade; 4th. That the canal is liable to be overflowed by freshets, rendering its use uncertain.

1. By a reference to the report of the Canal Commissioners of New York for the last year, it will be seen that on Geddes' lock, on the Erie Canal ("a single lock"), there were 191 lockages in one day, and a daily average of 153 lockages for a month, equivalent to 76 boats per day descending, or an average of one boat for every 19 minutes. We may then safely assume, that three boats can be passed downwards on the Chesapeake and Ohio Canal every hour, or 72 *boats in a day*, four less than the average number on the Erie Canal for a month together, and twenty-three less than the greatest number passed in one direction through a "single lock" *in one day.* The average load of coal boats, from the 1st January to the 1st April, 1853, has been 104¼ tons, no boat being allowed to draw more than four feet six inches. This average would have been much larger if the supply of coal had been greater and more regular, captains often leaving with short loads rather than be detained. The largest boat this year was 121½ tons. The experience of many years shows that 300 days of navigation may be safely calculated upon in the year; and this time, with a brisk trade, might be increased by the use of ice breakers, the ice rarely freezing so thick in this canal that it cannot readily be broken. Then, with a season of 300 days, with an average daily passage of 72 boats, carrying an average of 100 tons, the trade of the canal would be 2,160,000 tons of coal descending, yielding a revenue to the Canal Company, at the present rate of tolls, of 1,082,160 dollars.

2. The number of boats assumed above (72), can easily pass down through the tunnel by having fixed hours for leaving the ends; thus, four boats might leave the up-stream end at intervals of one hour and twenty minutes, alternating with four ascending boats, which would have collected at the lower end while the first were making the passage; this interval would allow forty minutes for the passage of the tunnel, which is more than experience has shown to be necessary.

3. A gauging of the Potomac at Cumberland, in September, 1838, during the remarkable drought of that year, there having been no rain for three months, gave 2,073,600 cubic feet of water in 24 hours. The quantity flowing in September, 1849, another extremely low stage of the river, was rather greater. From what I can learn of old persons living in this region, the river was lower in 1838 than it was ever known to be before; and I think the quantity of water flowing at that time may be considered a

minimum. At this time, with a depth of six feet water, it requires about 3,384,000 cubic feet of water per diem to supply the leakage and evaporation in the upper 50 miles of the canal, which would show a deficiency, in such a season as that of 1838, of 1,310,400 cubic feet. It is proposed, however, to obtain a supply of water from the Potomac, near lock 72, ten miles below Cumberland. At this point the river has received the waters of Evitt's Creek, with a flow, in 1838, of 656,640 cubic feet; a large limestone spring, flowing into the river near lock No. 72, supplying nearly a million cubic feet, and Patterson's Creek, which is about the same in capacity as Evitt's Creek. The supply to be obtained at this point will be about 2,000,000 cubic feet per diem during the dry season. Supposing the quantity necessary to supply leakage and evaporation to be in the same proportion for the upper ten, as for the whole fifty miles, there would be required for that distance a daily supply of 676,800 cubic feet, leaving 1,396,800 cubic feet to supply the lockage. The prism of lift of the upper lock is 15,000 cubic feet; from this deduct the water displaced by the loaded boat, say 133 tons, or 4,770 cubic feet, and we will have the quantity necessary to pass down a loaded boat, 10,230 cubic feet. If the descending and ascending boats alternate daily, there would be required but 72 lockfuls, or 736,560 cubic feet of water, leaving a surplus of 660,240 cubic feet, a quite sufficient allowance to make up for any irregularities of lockage. The canal may be supplied with water at several points below lock 72, as at the south branch of the Potomac, &c., and at very small cost,—the upper ten miles alone presenting any difficulties in the very driest season with respect to a supply of water. If, however, the trade should become so large as to require an additional supply in this portion of the canal, it will furnish the Canal Company ample means to construct a reservoir on Evitt's Creek, which would set at rest all question of difficulty on the score of supply of water for any amount of trade that will ever be brought to the canal.

4. With reference to the damage and detention from freshets, I will say that I consider the canal more safe in this respect than it has ever been. The points where the larger proportion of damage was done by the freshet of last April (1852), which was the highest by six feet ever known upon this river, have been made secure even against as great a flood as it was; and the condition of the canal at other points is such that I do not apprehend that either serious damage or delay can result from any ordinarily high freshet. In conclusion, I would say, that whenever the canal shall be worked up to its present capacity, the Company will have ample means from its revenue to treble its capacity, by doubling the locks, and by otherwise expediting the movement of boats.

Yours, very truly,

T. L. PATTERSON, Engr. and Genl. Supt.

REPORT OF H. T. WELD, ESQ., CIVIL ENGINEER, MOUNT SAVAGE (CHESAPEAKE AND OHIO CANAL.)

The Chesapeake and Ohio Canal is 186 miles long, from Cumberland to Georgetown, and, in that distance, has seventy-two locks, of eight feet lift each.

The locks were originally intended to pass boats of 100 feet in length, and 15 feet beam, with 5 feet draft of water; but, from various causes, the boats are limited in size to 91 feet length over all, and 14 feet 3 inches, or, at most, 4 inches beam, and the draft of water permitted has never yet exceeded 4 feet 6 inches.

In this depth of water, the capacity of the largest class canal-boat may be estimated at not exceeding 125 tons.

The largest class scow may be estimated at not exceeding 135 tons in the same depth of water.

As a datum on which to predicate calculations of the capacity of the canal, and the cost of transportation, I would assume a tonnage of 110 tons as a reliable limit for each boat or scow.

The limits to the capacity of the canal are: 1st. Power of the locks to pass boats; 2d. Supplies of water; 3d. Length of time the canal will remain closed in winter.

The locks may be emptied, and a light boat taken in, in about ten minutes; in other words, 12 boats an hour, for 24 hours, equal to 144 boats, gives (at 110 tons per boat) a tonnage capacity, for 250 days of canal navigation, of nearly 4,000,000 tons as a maxi um; but nothing being more liable to detention and accident and delay, than a canal-boat entering or leaving a lock, only two fifths of the above amount should be calculated on as the *practical* tonnage capacity of the canal with single locks. At the same time, there cannot be a doubt but that, with double locks, more than an equivalent increase of tonnage can be passed; besides, in the event of the construction of second locks, an additional eighteen inches in width might, at trifling expense, be given to them, which, in the increased burden of boats, would add 12 per cent. to the tonnage capacity of the canal as far as the new locks were used.

The proportionate increase in the cost of boats would be small.

The strength of the scow would be rather increased than diminished by the increased beam.

I make no mention of the limits to tonnage capacity occasioned by present arrangements at the tunnel, because passing places, cut at intermediate points through its length, would afford an effectual remedy, and at no very great cost.

In relation to the supply of water a good deal of explanation is necessary, and the question may be classed under two heads: that which is necessary for the single lockage, and that which is necessary to supply the evaporation and leakage of the canal.

In 1838, at probably the lowest period of water known,

measurements of the Potomac and Wills' Creek gave 21 cubic feet of water per second for the one, and 3 feet for the other; now, were the supply for lockage alone the requirement of the canal, this would give an abundance, and allow a fair amount to waste before feeding the lock.

The feeder at Cumberland, however, is required to supply all the wants of the canal from Cumberland to Dam No. 6, a distance of nearly fifty miles; at many points for this distance the canal widens out, and I think it would not be an unfair estimate to assume that between Cumberland and dam No. 6 there is an area of water surface of 600 acres, or 26,136,000 square feet, which, at a daily evaporation of half an inch, would require a supply of 1,089,000 cubic feet to supply the loss by evaporation, while the measured supply of the Potomac and Wills' Creek has been as low as 2,073,000 feet for the 24 hours.

And when to the loss by evaporation we add that of leakage and absorption in the banks, the result is, that when the supply of this fifty miles is reduced to the lowest gauge of water, there is a daily diminution of the water in the canal, until, as has happened, the boats are reduced to a draft of water equivalent to 75 tons burden, instead of 110.

This occurs during the month of July, when the evaporation is greatest, and even then is not probable to last more than two to three weeks at a time; while in September and October, during even lower stages of water than occur in July, the water supply has been ample.

There is sometimes a deficiency of water in the levels below Williamsport, owing to leakage and an imperfect dam, but the actual quantity of water at that point is abundant.

Assuming, therefore, that the scarcity of water will be limited to the fifty miles between dam No. 6 and Cumberland, it becomes necessary to seek first the actual water, and, secondly, the most effectual and economical means of feeding the canal with it.

For the first condition, Chief Engineer Fisk relied on two sources: 1st. Evitt's Creek, running into the Potomac five miles below Cumberland; and, secondly, the south and larger branch of the Potomac, about fifteen miles from Cumberland.

Evitt's Creek having its source from among the limestones, is more constant than the generality of the mountain streams, and might, I should think, be relied on in its lowest stage for two thirds as much water as is now admitted at Cumberland, or say 15 cubic feet of water per second, and flowing under the canal to the Potomac could be obtained at no extravagant cost.

The South Branch of the Potomac drains a much larger area of country than the North Branch, and is a more powerful stream. It could either be carried into the canal by means of an aqueduct across the Potomac at that point (which would be the more advisable course, in event of the formation of a slackwater naviga-

tion, ten miles up that branch, as has been contemplated), or a large pumping engine on the Cornish plan, would readily give the desired supply.*

In consequence of the small outlay required, Chief Engineer Fisk inclined to the plan of pumping engines, and it being a matter of practical certainty, from every-day experience, in the deep mines of Cornwall, that one bushel of coal consumed will raise an average of fifty millions of pounds of water one foot high, the annual expense of maintaining the engine presented nothing alarming.

He was uncertain whether to employ one single engine at the South Branch, or three smaller ones at different points along the line.

From the preceding observations it will be seen, that the waste of water is in the evaporation, and as this is constant without reference to the amount of transportation, will not be increased with it; and that, consequently, the supplies of water at command will insure sufficient for any amount of tonnage which will pass the locks. The estimate for pumping engine may be stated at $50,000.

The chief difficulties in transportation on the line of the canal have arisen,

1st. From breaks in the canal.

2d. Irregularity in loading and unloading.

3d. Accidents to boats on the canal.

Setting aside those breaks which are the result of floods, such as the great break of 1852, they arise in most instances from want of proper attention to embankment on sloping rock, sinks in the limestone formation, and the action of the musk-rat, whose small holes through the embankment, enlarged by the action of the water, gradually form a serious breach. The only remedy for these is vigilance and attention on the part of the supervisor.

Explosions of culverts can only be guarded against in construction.

Irregularity in loading and unloading can only be remedied by deposits at either end.

Sinking of boats by a heavy fine, where it arises from unseaworthiness in the boat, or carelessness in entering the locks.

We now come to the means and the cost of transportation.

Each canal boat running night and day requires three mules on each turn, and three will draw up to 120 tons without any very marked difference at low speeds, and as the number of hands employed is the same for 120 tons as for 100, every exertion must be made to secure this capacity in a boat in the very smallest possible depth of water, for nothing adds more to the dead pull of a

* An engine has been ordered, and the supply by it will be adequate. March, 1855. R. G. R.

canal boat than running close to the bottom, and as the size of the boats is limited by the locks, it becomes of importance to take every possible advantage of the size attainable. It is on this account that there is a difficulty in obtaining information from the experience of other canals, of the class of boat or scow best adapted in the long run for economical transportation. Boats may be classed as follows:

1st. Boats.
2d. Scows.
3d. Section scows.

My opinion is that a full length scow may be made to carry rather more, and yet tow as easily as a boat, that the repairs will be far less costly, and that to be of the same strength and accommodations they will cost three hundred dollars less.

The section scows will cost in building a little more than the full length ones; but as between the sections at the very least six inches must be left for play, the carrying capacity of the boat will thereby be diminished two tons, and in extra weight of materials one ton more, making a difference of three tons on each trip. In going through the lock at Cumberland, and at one or two other points on the canal, there will in high water be great danger of breaking the fastenings joining the sections.

In unloading a section boat at Alexandria, it will be necessary to make two holes into the coal instead of one, which I should judge would add two cents per ton to the cost of unloading, and certainly in extra breaking would damage the coal two cents per ton more.

On each trip, therefore, in point of economy, the whole scow would have an advantage over the section-boat on 110 tons, of

$4 40 for unloading and breakage, and
3 30 for extra burthen at $1 per ton;
———
$7 70

being $7\frac{70}{100}$ per round trip.

Now assuming the life of a scow to be ten years, and that during that time she makes 250 trips, then 250 × $7\frac{70}{100}$ gives a gross sum of $1,925, which according to ordinary calculations of repairs and depreciation would keep in repair, and at the end of that period leave a sufficient sum in hand to purchase a new boat.

Whether the saving in keeping a section-boat in repair is greater or less than this I have no means of saying.

One advantage claimed for the section-boat is in event of their sinking, the more easy raising the half boat than the whole. This is a fallacy; for when a boat from collision or other cause sinks in the canal, the difficulty consists in the leak being in some unseen part under water, and the consequent necessity of letting the water out of that level of the canal, in order to examine where it is and stop it. This once done the pumps soon

free the boat of water, and it will make barely any difference whether it is a whole or a half boat. The only point gained is that the cutting the boat in half strengthens it, and will probably diminish the expense of repairs.

The cost of running a canal-boat night and day may be assumed at about $180 per month, which at two and a half trips a month of 110 tons each, gives 275 tons per month

For each boat, or a fraction over, ...	65	cts. per ton.
To which, add for repairs, ...	8	"
Depreciation, ...	8	"
Depreciation of horse flesh, ...	2	"
An average of 20 days' detention from breaks, &c.,	6	"
	79	"

The general price paid has been about $1 05 net, which would leave about 26 cents per ton for profit; but so very great have been the delays and irregularities at both ends of the canals, in loading and unloading, that with very few exceptions the boat owners have rather lost than made money, while all acknowledge, that with proper attention to these points, they could have done a good business.

Ten boats will make a daily line; but in order to insure regularity from unavoidable delays on the canal itself, and in repairs, there should be three extra boats on hand, to load in case of detention, and which boats would take the place of the ones delayed, which delays are seldom more than three days.

For a trade, therefore, of five boats a day, sixty-five boats would be required, and good men would be found to take these boats, and horse them at the rates now paying per ton, who could afford out of their earnings gradually to repay the price of the boat. But the main important point to enable them to comply with their engagements, and do well, is to insure them against delays of loading and unloading.

Several experiments have been made with steam, and all have proved failures, and on the following ground: A tug-boat has started from Cumberland with two, three, four, or five boats in tow, the consequence of which was, that at each lock there was a detention of ten minutes on the first boat, then ten minutes delay in refilling, &c., making on one steamer and three tows a delay at each lock of 80 minutes, and on 144 locks up and down of $\frac{144 \times 80}{60}$ equal 192 hours, or eight days, the whole time occupied by a horse-boat in making the round trip—a circumstance in itself sufficient to destroy the enterprise, and to which must be added the difficulty of towing so long a string of boats round the short bends of the canal.

Now the plan which I have studied carefully, and would pro-

pose, is to use a small donkey oscillating engine, with tubular boiler, and screw in the dead wood of the vessel.

Such an engine, of 6 to 8 horse power, would, with water and fuel for a round trip, weigh about 13 tons, allowing the boat to carry a cargo of say 105 tons to 110 tons of useful freight.

Her expenses, limiting her to 3 miles an hour down, and $3\frac{1}{2}$ returning, might be stated as follows:

Engineer, 9 days, at $1 75, ...	$15 75
Helper (night shift), $1 25, . . .	11 25
2 hands, $1 00, ...	18 00
Coal, ...	6 00
Oil and repairs, ...	6 00
110 tons costing	$57 00—$51\frac{7}{10}$ cts. per ton.

Or limiting the speed to $2\frac{1}{2}$ miles an hour, with one tow, and 11 days' time, my calculations come as follows:

Engineer, 11 days, ...	$18 75
Helper, ...	18 50
2 hands, ...	22 00
2 extra hands, ...	22 00
Coal, ...	8 00
Oil and smithing, ...	8 00
220 tons,	$92 25—42 cts. per ton.

Horses or mules for a single boat would cost . .	$700 00
Engine, ...	1000 00
Difference in favor of first cost of mules, &c.,	$300 00
Horses and mules for 2 boats, ...	$1400 00
Engine to draw 2 boats, at lower speed, . .	1100 00
Difference in favor of first cost of engine,	$300 00

To make the experiment of steam under this plan would require an outlay of not exceeding $3,000. As a natural result, there would be a great economy in having, in event of a break on the Canal, and during winter, a non-consuming power, besides that the yearly depreciation of horse-flesh on a canal cannot be rated at less than 20 per cent.

All which is respectfully submitted.

HENRY THOMAS WELD.

Mount Savage, June 30, 1853.

COST OF MINING THE COAL, AND GETTING IT TO MARKET.

I had made estimates of the cost of mining and transporting the coal to market, but found, on comparing them with the re-

ported cost of other parties, that they so far exceeded them, that I submitted my estimates to C. Slack, Esq., whose long experience and practical knowledge give to his opinions great value. His estimates may be relied on with entire confidence, and I accordingly submit his correspondence on the subject.

MOUNT SAVAGE, MD., *February 26th*, 1855.

R. G. RANKIN, ESQ., New York:

DEAR SIR:—I inclose herewith the estimates requested in your favor of the 19th inst.; also *copy* of your "Estimate for mining 50,000 tons per annum," the original having been accidentally mutilated.

You will observe, that in the preparation of the estimate of outlay required in opening the mine, so as to place it on a business basis, for fifty thousand tons, I have arrived at a result not essentially different from yours.* In some cases I conceived the estimate too low, in others excessive, while other items not embraced in your paper I have added to mine. My opinion of the sufficiency of this estimate for the purpose in view is so decisive, that with the idea of reducing the sum, I abated 10 per cent. of the item for "Contingencies." In estimating the cost for dead work, graduation, &c., I based my figures upon what was about the *average* expenditure incurred by coal companies of the region for such work, which, in the absence of definite information touching the particular locality in which the improvements are proposed to be made, was the only plan I could adopt. The aggregate sum, however, contemplates a sufficient margin.

The paper relative to the cost of mining a ton of coal and sending it to market, was prepared with great care, and I commend it to your confidence as the result of close investigation of the subject. I have had occasion, in the course of several years' experience, to know, that placing the item of *mining* at 35 cents per ton (the present rate paid), the average cost of the coal placed upon the cars, in quantities not exceeding the rate of fifty thousand tons per annum, cannot be less than 56 cents. I have seen estimates of various companies, who place the rate ranging from 49 to 55; and in regard to the extent which a larger trade might affect the rate, I would give it as my opinion, that mining 75,000 tons per annum, it might be reduced to 53 cents; 100,000 tons to 49 cents, &c. In a business of the magnitude of 300,000 tons per annum, I believe (placing the item of mining at 30 cents, to which I think that feature will be ultimately and *permanently* reduced), the coal could be placed on the cars at 42 or 43 cents per ton.

The "freight to Cumberland" I have conjecturally placed at 36 cents. The rate now is 30 cents from *Frostburg* to Cumber-

* My estimate was $35,953 43.

land. The rates of toll by canal, and also the freight, are those of last year. My opinion is, that as the Canal Company have consummated arrangements which look to a more regular and copious supply of water during seasons of drought, the boating will, in the course of a year or two, be done at 1¼ per ton, or less. If so, the cost on shipboard at Alexandria will be proportionably reduced. The prospect is, that if any change of tolls by railroads be made, it will be *advanced* rather than reduced; at present, the difference in cost by the two modes of conveyance to the seaboard does not vary from 50 cents per ton in favor of the canal.

Should it be contemplated to ship coal by the last named, it would be necessary to provide cars for the purpose. Ten cars, costing $500 each, would be sufficient to deliver one hundred tons daily at the canal, from the "Aspinwall" property, south of Frostburg. The same number are enough to deliver *two* hundred tons from the mines now worked by the Frostburg and other companies near that village.

Your inquiry embraces the item of "Insurance guarantee." I have at hand no means of reply to this question, but I believe that most of the companies keep an open policy, insure only at particular seasons of the year, and that the rates of insurance are inconsiderable.

Trusting you may be enabled to gather from the accompanying papers some points of information which may be of use,

I am, respectfully, your obedient servant,

C. SLACK.

No. 1.

FROM "ASPINWALL" PROPERTY VIA FROSTBURG TO ALEXANDRIA.

Estimate of the cost of getting out a ton of Cumberland Coal and sending the same to market, based upon a trade of 50,000 *tons the first year.*

Expenses inside:	cts.	
Mining,	85	
Labor on trackway,	1·25	
Salary of chief miner, and weighing,	1·71	
Props, ties, and cap pieces,	1·28	
Oak scantling for trackway,	1·10	
Iron rails,	·55	
Ventilation, repairs, and renewal of tools,	·90	
Hauling out,	8	
		44·74
Oil and axle grease,		70
Repairs Cars:	cts.	
Iron and Lumber,	·63	
Labor,	·56	
Renewal of wheels,	.60	
		1·79

Loading into large cars:		
Weighing and manifesting,	·90	
Labor,	2.00	
		2·90
General expenses:		
Superintendent,	3	
Labor,	·87	
Contingent and Miscellaneous,	2	
		5·87

Costing per ton, delivered into the large cars,		56 cents.
Freight to Cumberland,		36
Use of cars (or, if owned by the Co., repairs same),		5
Wharfage and transhipment at Cumberland,		8
Canal tolls to Georgetown,	46	
Canal tolls to Alexandria,	4	50
Canal freight to Alexandria,		1 25
Commission, wharfage, and labor at Alexandria,		20
Costing on shipboard at Alexandria,		$3 00 per ton.

No. 2.

"ASPINWALL PROPERTY," VIA FROSTBURG TO BALTIMORE.

Cost on large cars (as above) per ton,	56
Use of B. & O. RR. Co.'s cars,	5
Freight to Cumberland,	36
Freight to Baltimore,	2 25
Commission, wharfage, and labor at Baltimore,	20
Costing on shipboard at Baltimore per ton,	$3 42

No. 3.

RAVENSCRAFT PROPERTY,* VIA PIEDMONT TO BALTIMORE.

Cost on large cars (requiring use of incline plane),	61
Freight to Piedmont, 9c.; use of cars, 3c.,	12
Freight to Baltimore,	2 55
Commission, &c. &c., at Baltimore,	20
Costing on shipboard at Baltimore,	$3 48

Estimate of expense for getting out 50,000 *tons of coal per annum.*

Graduation and tracks for full and empty cars, 56″ rail, 1200 ft., at $2 12 per foot complete,	$2,544 00
Load house, approach tracks, and fixtures,	1,500 00
Large and small scales, with sheds,	800 00
60 mine cars, at $40 00,	2,400 00
Opening dead work for placing 50 miners, timbering, drift tracks, ventilation, and materials,	1,500 00
Miners' tools,	300 00
Mules, horses, and harness,	500 00

* Now belonging to the Central Coal Mining and Manufacturing Company.

Shops, including tools for repairs, . .	400 00	
Storehouse and fixtures, ...	600 00	
20 dwelling-houses for miners, at $300 each, .	6,000 00	
Building for office, and furniture, . . .	400 00	
Salaries, agencies, and engineering, . .	5,000 00	
	$21,944 00	
10 per cent. for contingencies, . . .	2,194 40	
		$24,188 40
To pay railroad tolls to Cumberland, per 4166.16 tons monthly, ...	$1,500 01	
To pay railroad tolls on same quantity monthly to Baltimore, at $2 25, ...	9,375 07	
Store goods, ...	2,000 00	
		$12,875 08
Total, ...		$37,018 48

Art. II.—THE MINES OF FRANCE.

The French people, although possessing the best "school of mines" in the world, that of Paris, are not so eminently a mining people as the English, and excepting some mines of coal and of iron, a few lead mines and some quarries of stone, they have but little mineral wealth in the country—coal is found in seven of the Departments of France both bituminous and anthracite; but is of an inferior quality, abounding in earthy matters; consequently the French are obliged to import from England and Belgium their best coals, and the channel seaports depend mainly upon England for supplies for steam vessels. Much more coal, however, is now mined in France than formerly in consequence of the construction of rail-roads by which additional facilities for transportation are obtained. Nevertheless, wood appears to be the main dependence of the people for fuel, and this is the most expensive article of common consumption in that country, being sold by the pound, and used very sparingly.

The principal mines of coal now worked are those of central France, near St. Etienne, 35 miles from Lyons, from which there is a railway communication extending to Paris. The coal measures here are the most extensive of any in France; mines are worked under the streets of the city of St. Etienne, which has a population of 72,000, being the largest town in the *Department de la Loire.* This place has been called the Birmingham of France, and abounds in manufactures of fire-arms and ribbons; 30,000 stand of arms are made here annually, and in the time of Napoleon le Grand the

manufactures of arms reached 60 to 100,000 per annum. The city is literally like Birmingham in England, "the child of coal." The cost of a musket, is but 10 or 12 francs ($2, or 2,50). The city has a Museum which contains many fossils of the coal field besides other interesting minerals. At Le Chambon, in the valley of the Furens near St. Etienne, there are coal mines, manufactories of cutlery, nails, saws, etc. At Fermigny, in the same vicinage, there are also many coal mines, some of them worked like quarries, open to the sky. A vein of coal has been opened here 32 feet in width. At Rive de Gier, a town of 12,000 inhabitants, situated in the same coal measures, there are at least 40 coal mines that are supplied with steam engines, to elevate the coal and free the mines of water. There is a large glass manufactory in the town and a manufactory of steel, owned by the Messrs. Jackson (Englishmen), where the best steel in France is manufactured. Lyons is chiefly supplied with fuel from the mines of Rive de Gier; Marseilles, Mulhausen, Nantes and Paris also obtain supplies from thence. A considerable quantity of iron ore (iron stone of the coal measures), is mined here and reduced to metal by the furnaces of St. Chamond, Bruges, etc.

Iron ore is also obtained in the Eastern Pyrenees. The iron here occurs near the junction of the limestone (of the age of the chalk formation) with the granite, near the village of Valmania. The coal field near Le Puy (Central France) presents an object of great interest to geologists. The crater of Jaujac, an extinct volcano, four miles below the village of Thueyts, has forced its way through the coal formation, which lines the bottom of a *triangular* shaped basin; near it is a majestic colonnade of basalt, 150 feet high, and one mile and a half in length.

At Pontgibaud, thirteen miles from Clermont, in Auvergne, are mines of argentiferous galena, which is smelted, and the silver separated from the lead, in extensive establishments, erected for the purpose, by the well-known "process of Auvergne." Auvergne is a volcanic region, and possesses many extinct volcanoes of remarkable interest to the geologist.

At Coudes, on the banks of the Allier, in Auvergne, are quarries of a peculiar variety of sandstone, named Arkose, which is used for millstones. At Corent, farther down the river Allier, quarries of fibrous gypsum are worked. Near the village of Perrier, on the Allier, is an interesting geological section; here are found the fossil remains of extinct quadrupeds: the mastodon, tapir, rhinoceros, elephant, &c. The Puy di Marmion, near Veyre, in Auvergne, is celebrated, among mineralogists, for its beautiful crystallized specimens of mezotype, contained in the volcanic tuff and basalt, of which it is composed. An excellent mortar is made in this section from scoriæ and volcanic dust (pozzolana). In a lava current in the vale of Royet, in Auvergne, may be seen a large quantity of half-burned cereal grains. In

the opinion of Dorbeny, some of these curious volcanic remains must have been produced since the time of Cæsar, inasmuch as that general does not mention them in his "Commentaries," although his army was encamped near them, on the plateau of Gergovia. There is no record, however, of the period of these volcanic eruptions.

At Volric is an extensive quarry of lava, which is used as a building stone in the town of Clermont. It is easily worked; and huge blocks, 20 feet by 6, are obtained; when first quarried it is of a gray or slate color, but soon becomes dark by exposure.

At Aigueperse, in Auvergne, a kind of oolite rock is quarried for building stone; this rock underlies beds of tertiary limestone, entirely formed of the cases of insects, incrusted by carbonate of lime, and formed into a hard travantine called "Calcaire à friganes." Innumerable tubes are coated with shells of the *Paludina.*

At Menat, in Central France, are quarries where tripoli, or polishing slate, is obtained; it is produced by the spontaneous combustion of iron pyrites among beds of bituminous clay. It contains impressions of vegetables, fish, and insects.

At Fontainebleau are sandstone quarries, from which considerable quantities are transported down the Seine to Paris.

At Caen, in Normandy, are quarries of an oolite rock (equivalent to the Stonesfield slate of England, but without its slaty structure); these quarries are extensively worked. Canterbury Cathedral, Old London Bridge, Winchester Cathedral, and many other public buildings in England, are constructed of it. A considerable quantity of this stone is now brought to New York from Havre, as ballast, and has been used in the construction of the Nassau Bank, and other buildings.

At Mount Pertius, near Yssingeaux, in Central France, a kind of clinkstone is quarried for roofing slate.

At several places in Normandy, chalk is obtained, especially near Rouen.

At Cherbourg granite and slate are quarried, and used in the construction of the docks at this port, which promises to become the most important in France. At the valley of Campau, in the Pyrenees, some twenty varieties of beautiful marble are obtained; the flesh and green colored are the most prized; a blood-red marble is also obtained, which contains fossils of the nautilus; near the quarries are manufactories for making ornaments of the marbles.

The mines of France are under the superintendence of the Director General of the Government, M. Elie de Beaumont, who does not permit a mine to be spoiled by unskilful works, as in some countries. H. A. H.

ART. III.—NOTES ON THE GEOLOGICAL FEATURES OF THE PANAMA RAILROAD.—BY DR. ISAIAH DECK, MINING GEOLOGIST, &c., NEW YORK.

The author, during his professional duties, having had opportunities of visiting, at intervals of some months, that district of New Grenada which comprises the above important and spirited undertaking, has endeavored in his rough scrambles across the Isthmus to collect such facts as would, from personal observation, form a nucleus to a series of explorations which an engagement, now *en tapis*, from Chiriqui along the Atlantic coast to Venezuela, will shortly enable him to give many months attention to.

The physical appearance of the country, as observed from the sea, presents nothing geologically interesting; the high lands almost encircling Navy Bay, and varying from an abrupt descent to a gentle undulating slope, are bounded in the distance, easterly by the high trap range of Portobello hills, extending round to the promontory inland, on the western base of which is built the town of Chagres, the delta of whose river, composed of the alluvial debris and washings from the internal forests and swamps, has been the frightful source of its dreaded fever.

Commencing at the terminus on the western side of the island of Manzanilla, and on which the thriving town of Aspinwall is built, we have an interesting example of the formation of coralline reefs and deposits; these indefatigable but silent architects of present and future continents, comprise on this side of the Isthmus those varieties of polypifers known as *Millepora* and *Nullipora*, with the reef-building *Porites;* and there is a perfect evidence that the foundation on which the coral was primarily attached has subsided, and that during this downward movement the reef has grown upwards.

The base of the island for some distance above high water mark, is composed of coralline limestone of recent formation, mixed with comminuted shells, sand, and crustacea, extending seaward, and inland forming ridges or terraces, alternating with dyke-like deposits of alluvial mould, and decomposed and decomposing coralline detritus. In some parts of the island this latter deposit is spread superficially 3 or 4 feet in depth, and affords a rich soil for the Manzanilla cocoa, palms, and other large trees; while the substratum yields a most compact breccia for the foundations of the various workshops and buildings required by the Company. The area of the Island is from 6 to 700 acres, and is yet in many parts undrained and uncleared from the swamps and rank vegetation so characteristic of these singular formations in the tropical seas.

The general aspects of the line of cutting from ocean to ocean, indicate an upraised series of marine beds, or terraces (with occasional depressions from abrading action), one above another, un-

til the summit level or water-shed of the rivers is reached, 38 miles from the Atlantic. The direction or course of these elevations remains pretty constantly N. E. and S. W. Their geological position may be readily assigned to the tertiary formation, and particular age to the pleiocene epoch; the upheaving has been uninterrupted and gradual, and readily explained through the underlying trap rocks, which rarely make their appearance on the surface, but are occasionally exposed by the deeper cuttings, or by the abrading action of the rivers and mountain torrents winding through the ravines.

From the island to the distance of 3 miles, there extends a low swampy level, naturally quite impracticable for a road. This has been entirely overcome by engineering skill, and securely and admirably filled in with cribbing, piles and compact earth, and continued in the same substantial manner for a further distance of 6 miles, except where the occasional intervening outliers of naturally firm deposits render it unnecessary.

At the above 3 miles, the first signs of a firm foundation appear at "Monkey Hill," an eminence of about 30 feet, and comprising an arenaceous friable marl, with remains of cardia, pectens, turritella, and other bivalve and univalve shells, interspersed abundantly through the mass, without any attempt at stratification. In this and the corresponding formations, the bivalves retain their two valves, united by the hinge, and the burrowing kinds retain their natural position, showing gentle and gradual upheaving.

Leaving Monkey Hill, which is evidently based on a spur of the Portobello hills, a range extending in advance and backward N. E. and S. W., and the exact counterpart of which formation we meet near Chagres, we progress over the same characteristic swamp to Gatun, a town and station on the Chagres River, and whence the main supply of water for the service of the Company is conveyed to Aspinwall. Here, the Monkey Hill deposit reappears, capping the hills and based on a blue marl, without any visible fossils, and nowhere again along the present cutting does the coarse shelly marl previously noticed reappear. Here commences the first gradual ascent of the line, and the sides of the hills take the usual direction, sloping away to the east. Again passing a swamp, triumphed over as its predecessors, we arrive at Tiger Hill, about 12 miles on the line, where one of the principal quarries worked for the use of the Company is situated. The superstratum is a deposit of blue marl, similar to Gatun, but more compact; beneath which is a soft and rather friable calcareous sandstone, slightly effervescent with acids, not readily cleavable, but hardening much by exposure. It is evidently nothing more than an indurated silicious marl, but adapted in the absence of better material, to the construction of the culverts, which the state of the road in the rainy season demands so extensively along the

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The Chagres river, receiving its principal supply from this ridge, and its numerous spurs and ravines, rises considerably after heavy rains, often as much as 40 feet in four hours, but its banks are precipitory, and its sides hilly and of sufficient depth to save the surrounding country from inundation, while the line of railway is elevated, and sufficiently compact and ballasted, to withstand any contemplated rise.

Where the dip of the uptilted strata can be carefully observed in this spot, it is at an angle of 40° N. by W., and the reverse on the other limb of the anticlinal axis. The highest on any other

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The river Obispo, near this portion of the line, has two fine and picturesque falls over a well marked ledge of columnar trap, in its total depth of 75 feet. This is a most positive and interesting evidence *in situ* of the nature of the foundation and cause of elevation of the strata.

From Obispo to the summit is 7 miles, at a rising grade of 60 feet to the mile. The cutting is mostly through the previous character of stratification; the marl beds indurated by contact with the protruding trap, which is here met with *in situ* on the line of cutting for the first time, and which continues uninterruptedly as we reach the summit level, 275 feet above mean tide of the Pacific. The cutting is here 25 feet deep, on to a portion of the underlying trap, and 1,300 feet in length. The work here has

line; it is readily procurable, and in the quarry exhibits a fine perpendicular ledge to work upon in its line of clearage.

Continuing ón to Ahorca Lagarto, we cross a level diluvial plain, or river bottom, near an angle of the tortuous Chagres River, and which frequently temporarily inundates the surrounding country, but the sandy subsoil allows it readily to percolate, occasional outliers of calcareous sand, and the aluminous marl characteristic of this period of formation, require excavations of from 5 to 15 feet. At Ahorca Lagarto is another compact deposit of indurated arenaceous marl, used also for abutments and bridges. This is more marked in its features than the former; is harder, easier split, of a much lighter color, and altogether of better quality. Onward, skirting the Chagres, to a similar deposit at Bujio Soldato, and to Frijol, where abrupt curves of the road and river show some interesting features, we proceed along a rich fertile plain to Barbacoas, an important station 23 miles on the line, and for many miles situated above the river sufficiently to be unaffected by rains or floods.

Here we again encounter a deposit somewhat similar to the previously visited quarries; but the stone is so decomposed and friable, as to be quite useless. But at San Pablo, 4 miles further, an excellent hard compact stone of a cream color is found, and which is superior to any other along the line, and admirably adapted for the construction of the abutments of the noble bridge here crossing the Chagres, for a length of 600 feet, and which is the *chef d'œuvre* of engineering work on the line.

This locality is the most interesting portion of the cutting; it is the commencement of the dividing ridge of the Isthmus, and spurs, with numerous ravines, stretch out into the country in a west and south-east direction for many miles.

Here has evidently been the anticlinal axis of the stratification, but subsequently to the protrusion of the igneous rock, a shrinking and corresponding depression has occurred, and the deposits present a perfect chaos; aluminous earth, sandstones, coarse gravel, and trap fragments, and a friable porous kind of pumice, not met with in any other section, are heaped confusedly together, in alternating ridges and beds, and merging imperceptibly into each other.

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part of the line is 23°, averaging generally 10°, and north-easterly.

From Barbacoas to Gorgona (29 miles), the most important village on the line, and where one of the early beaten mule paths to Panama commences, is the usual swampy level along the right bank of the Chagres river, and on to Matachin, a most interesting locality. Here the Chagres, after sending a branch to the north-east, on which the town of Cruces is built, unites its waters with the Obispo, and the two rivers, after many tortuous wanderings, individually fall into the Atlantic and Pacific. Indeed, the very raindrops dripping from either side of the humble habitations, or the small watercourses from the ridges, fulfil their respective missions in swelling the tributaries to these rival streams and oceans, upon whatever side of the roof they may chance to fall.

From a cursory observation made at Cruces, I am disposed to think that in its vicinity, in a north-east direction, the source of the Chagres may be looked for; the spurs and ravines in that direction indicating its origin and continued supply.

Matachin has been the spot chosen for the erection of the monument to commemorate the opening of the entire line, and a more suitable locality could scarcely have been selected. About two miles to the south, is an elevation which has an artificial aspect, but is only one of the numerous outliers of smaller size, based on the trap range. From this hill, a clear view of the two oceans can be taken, and reference is made to such an elevation and aspect in the voyages of the companions of Columbus, and from the physical and geographical description is undoubtedly the spot indicated. In the cuttings in the vicinity, imbedded in the marl and sand, are found interspersed fragments of chalcedony, chert hornstone and jasper, the edges only *slightly* rounded by attrition, a further proof of its original deep sea level, and of its gradual upheaval. In some of the more compact strata in the vicinity, small crystals of quartz, from one third to one inch long, and with unabraded angles, are found plentifully deposited in cavities and geodes.

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been admirably executed, and, indeed, along the whole course of the line there has been nothing deficient in this department. The strata here dip towards the Pacific, at an angle varying from 15° to 23° east.

The grade from the summit towards the Pacific is 75 feet to a mile, and is, after passing some ravines and spurs from the distant mountain ranges, gradual on towards the "plains," an arenaceous bottom, with alluvial superstratum, through which the "Rio Grande," and its north-eastern branch, the "Cardenas," flows on to the Pacific. These sandy plains and marshy detritus increase as we approach Panama.

The various mule routes to the east of the line to Panama, and which, with the canoe transportation up the Chagres river, formed the only means of traffic for the adventurous Spaniards between the important cities of Portobello and Panama, possess considerable interest. The path from Gorgona is shorter, and possesses less physical difficulties than that from Cruces, but can only be used in the dry season, whereas the latter is, from its elevation and circuitous route, far above the interruption of inundation.

An interesting feature on the latter road, is shown in its being cut through on its ridges from the strata above, until it reached the solid trap rock, and a path of the firmest possible nature obtained. The mules following in single file, and invariably taking the same steps as their leaders, have worn holes from 10 to 15 feet deep in the softer portions, with a varying width of two or three feet, and so steep that only a mule can climb them, and with regular footsteps or hoof-holes for long distances, and for a period of three or four centuries have kept the same track.

The present terminus at Panama is at Playa Prieta, just outside the walls, and north of Compelly, and it is contemplated to carry it about three miles further over the alternating coralline and trap formation, to one of the nearest islands in the bay. These are the Pineo and Flamingo islands, mere outliers of trap, with a rich surface soil. The larger island of Taboga, six miles further, is a protruded trap-rock of later elevation than the preceding islands, appearing to have no connection with them; the intervening distance being a bottom of coralline detritus.

The glorious scenery of the Bay of Panama, viewed either from the elevation of this tropical fruit garden, or from the walls of the city, so interesting in its past and future contingencies, I will not attempt to describe. Like Constantinople, from the Golden Horn, once seen under favorable aspects, it must be treasured as the acme of perspective beauty, such as even the pencil of a Claude or Canaletti would fail in depicting; while to those unfamiliar with tropical characteristics, the attention along the whole line of railway is divided between the magnificent forest trees and vegetation, hanging vines and gorgeous parasites,

and the feeling that to American skill and enterprise alone, is the traveller and commercial world indebted for the successful triumph over difficulties deemed insurmountable, and the completion of a project which must exert a great political and moral advantage to both hemispheres.

To Col. Totten, the projector, and engineers of the route, Mr. Center, and Mr. J. S. Hollins, I am indebted for marked courtesies and liberality extended during my investigations, and the employees of the Company generally, afforded every assistance and information towards rendering my observations as definite and satisfactory as the time at my command allowed.

Art. IV.—A GENERAL VIEW OF THE ANTHRACITE COAL REGION OF PENNSYLVANIA. No. 1.—By Henry W. Poole.

All of the anthracite coal of the United States, if we disregard a small area of unimportant beds, has been deposited in Pennsylvania, and is contained within the limited space of three hundred and fifty-six square miles. Bituminous coal is estimated to cover 133,000 square miles, of which there lies within Pennsylvania about 15,000.

That we may obtain some idea of the quantity of anthracite which is here laid up in store, it may be assumed that an average thickness of 25½ feet can be taken to market. This may be too much or too little, as the thickness at various points is widely different; the section of one locality where the veins are thick and steeply inclined, showing a vertical thickness of over 100 feet, while that of another exhibits nothing worth mentioning. The quantity of coal in the 356 square miles, if 25½ feet thick, is 9,378,236,908 cubic yards or tons (9,378 millions).

When quantities reach such a stupendous magnitude as this, it becomes almost impossible to judge of them without considerable reflection or some illustrative aid. To this end is offered the following supposition:—

Let the whole 356 miles of anthracite land be arranged as a level square, whose sides will measure a little less than 19 miles; and upon a square mile in its centre, build up a *cubic mile* of its coal. This cube will contain 5,451,776,250 cubic yards or tons. To dispose of the remainder of the coal, the pillar could be continued seven eighths of a mile higher, when the summit would be elevated 8,976 feet above the plain.

To continue by this diagram since the coal trade commenced thirty-five years ago, up to the beginning of 1855, 48,907,860 tons have been taken away, reducing the height of the column

47·422 feet. The production of 1854, (5,847,369 tons,) has taken off 5·6566 feet, or nearly one eighth of the whole removal.

The increased production of the last year has been nearly twelve per cent. over any previous year. The *demand* quite reached the supply. If the demand for the coming years shall increase at the rate of ten per cent., there will be required in 1875 about 44 millions of tons, and between this and that year, 334 millions. So much will be *required;* and if the means of mining and transporting it, (the last is the only doubtful point,) are sufficient, 321 feet more of the column will have disappeared. The total diminution of its height will then have been 368 feet, and its top will still tower at an elevation of 8,607 feet, or nearly a m ileand a half.

There is no need to proceed further with these estimates. If the thickness of the coal be not over-estimated, it is very clear that the present generation need have no anxiety regarding the failure of the fuel magazines in the mountains.

But if it be likely that there will be required, as early as the year 1875, forty-four millions of tons, it is deserving of thought how to get to market such a stupendous mass of fuel. The demand is destined to increase almost indefinitely; but can the supply keep pace with it?

During the past season, every person has felt that the price of coal has been very high. The reason, without doubt, has been the insufficient production of the mines, and the want of greater facilities of getting to market. There was not any unusual stoppage in either department, for the coal sent off exceeded that of any other year by 652,000 tons. If it be asserted that the demand has been finally met, it must be taken into consideration that the very high prices have compelled many to use other fuel, who otherwise would have burnt anthracite coal.

The following is the general form of reporting the different regions, together with the quantities sent to market from each in 1854:—

S.	Schuylkill Region—	
	By Reading Railroad,	1,987,854
	By Schuylkill Canal,	907,354
S. & M.	Lehigh,	1,246,418
N.	Wilkesbarre,	492,689
N.	Lackawanna—	
	Delaware and Hudson Canal and Coal Co.	440,944
	Pennsylvania Coal Co.	496,648
M.	Shamokin,	63,500
S.	Lyken's Valley,	57,500
S.	Dauphin Co.,	63,000

These names, although they are those by which coal is generally known, indicate only the avenues by which it gets to mar-

ket, and are not distinctive either of the locality from which it was mined, or its quality. A closer and more accurate subdivision than the above will be made hereafter, and a description, more or less detailed, of each particular locality.

The entire region is divided into three separate coal fields, the Southern or Pottsville, containing 115 square miles, the Middle, with 121 square miles, and the Northern or Wyoming, with 120 square miles.

The coal called "Schuylkill" comes from the central parts of the Southern field. The "Lehigh" takes its name from its being forwarded through the Lehigh Canal, and is produced both from the mines of the Lehigh Company in the eastern end of the Southern field, and from the several detached basins of Hazleton, Beaver Meadow, &c., of the Middle coal field.

The "Wilkesbarre" coal and the "Lackawanna" both belong to the Northern or Wyoming coal basin. The first is mined in the western half, and generally goes westward down the canal along the Susquehanna, and is chiefly consumed by the iron works along the line, and at Baltimore; while the latter, from the eastern portion, is carried eastward by railroad and the Delaware and Hudson Canal to the Hudson River. The Shamokin coal comes from the western end of the Middle coal field; and the Lyken's Valley and the Dauphin from the western extremities of the Southern basin. Excepting a very small quantity, the coal of the central portion of the Middle coal field has not yet appeared in the markets. Extensive preparations have been made to bring out this excellent coal during the present season, facilities being now provided for its transportation by the extension of the Mine Hill railroad to Ashland, over which it will be carried to the seaboard at Philadelphia.

The purpose will be next to consider the present and contemplated avenues, by which, if at all, the future coal must be taken to market.

And, first among these is the Reading railroad, which extends from the centre of the Southern coal field, along the Schuylkill river, a distance of 93 miles to Philadelphia and to the company's shipping wharves at Port Richmond, on the Delaware river. Over this line and through the Schuylkill Navigation Company's Canal, running parallel with it, must be taken all the coal which is brought from the collieries by five railroad companies, viz.: the Mine Hill and Schuylkill Haven, the Schuylkill Valley, the Mill Creek, the Mount Carbon, and the Auburn railroads. The Mine Hill road alone consists, besides its main line, of eight principal branches, and comprises altogether about 100 miles of road, which penetrate to about 90 mines, some of which produce 500 tons per day. The Reading railroad, during the last year transported nearly 2,000,000 tons. It is stated by those who should best know, that it is practicable, when the quantity of coal re-

quires it, and the requisite additional engines, cars, and sidings, shall be provided, to send over the road, for 40 successive half-hours of each day, a coal train of 100 cars, or 500 tons; amounting to 20,000 tons per day, or 6,000,000 tons in a year of 300 days. This route,—being the shortest to tide water, and having the advantage of a constant down grade, in the direction of its heavy traffic, of such descent as to nearly equalize the power needed to take down loaded cars, and to return them when discharged,—there is every reason to believe will continue to hold its present rank.

If it be assumed accordingly, that the Reading road will in 1875 have a capacity of 6,000,000 tons, and that by other avenues proportionate quantities will be transported, the result will be somewhat as follows:—

Reading Railroad	6,000,000
Schuylkill Canal	2,500,000
Lehigh Canal	3,000,000
Pennsylvania Canal	2,000,000
North Branch Canal	1,000,000
Delaware and Hudson Canal	2,000,000
North Pennsylvania Railroad	3,000,000
Proposed railroads to N. Y., etc.	8,000,000
Total supply	27,500,000
Deficiency	16,500,000
	44,000,000

From which it appears probable, that there would be a difficulty in meeting the demand of 44,000,000, and that a deficiency of 16,000,000 will have to be made up from the regions of bituminous coal. According to R. C. Taylor's statistics, the production of Great Britain in 1845 was 31½ millions of tons.

(To be Continued.)

Art. IV.—ON THE DURABILITY OF RAILROAD IRON.*—By William Truran, Esq.

The duration of the iron rails of our great railroads is a subject of vast importance to all interested in the maintenance and extension of railway communication. In all estimates for new roads for thinly settled districts, the cost of the iron rails figures as the most prominent item; and even in the thickly settled States of Europe, where the metal is obtained at a comparatively cheap rate, the cost of the rails forms no inconsiderable portion of the whole expense of construction. On the first introduction of railroads, it was confidently asserted by their promoters, that the iron rails would last for an indefinite period. A few months

* From the Journal of the Franklin Institute.

working, however, demonstrated that although manufactured from the best metal, iron railway bars were subject to lamination and disintegration from the repeated rolling of heavy loads. Their duration, in numerous cases, did not exceed two or three years, and in no instance of a railroad having a heavy traffic, have the rails remained sound and in working condition for more than 14 years. On some of the earliest constructed lines in England, the rails have been changed twice and even three times within twenty years. Opportunities have, therefore, presented themselves to the engineers of such lines, of ascertaining the actual traffic which iron rails are capable of withstanding under different circumstances. But if note has been taken of the facts relating to rails which have been taken up, it is to be sincerely regretted, that they have not been recorded in one of the numerous scientific publications of Europe or this country. Their publication would be of the greatest benefit to railroad companies, and, eventually, would be of essential service to engineers and scientific men generally.

The traffic which rails of ordinary quality are capable of bearing, will depend on circumstances; but where the conditions are of a favorable nature, and the bars themselves perfectly sound, it will not fall far short of twenty millions of tons. But, although rails will stand the rolling of this traffic, those which are daily observed in a dilapidated state on numerous railways, have not, in the majority of cases, carried the one fourth of this traffic; and immense quantities of rails have doubtlessly been renewed before they have borne the one tenth of this weight. Well recorded observations are wanted on this head, and pending the publication of more extended observations, the writer would direct attention to the following observed cases of rails, which have stood the carriage of several millions of tons under very disadvantageous circumstances.

It may be necessary to state, that the rails used in every case, but the last, were of the usual quality (those in case 2 are a portion of the bars manufactured for the Moscow and St. Petersburg railway). They were manufactured in the manner commonly pursued at Welsh rolling mills, and were, in point of quality and appearance, equal to any manufactured, or in use in Europe. The rails in the Hirwain road were rolled from inferior metal, and were not, in other respects, well manufactured.

It may be necessary also, to mention in this place, that the gross weight of the trains is given in every instance. This, it is believed, is preferable to giving the weight of the freight and omitting the weight of the engine and cars, which may be unnecessarily heavy or light for the loads which they convey.

CASE 1. Railroad for the conveyance of minerals, near Merthyr Tydfil, Wales, length, 2 miles; gauge, 4 feet 8·5 inches. This line is a gradient of 2 inches rise in the chain through its whole length, and contains curves so low as 3 chains radius.

The wagons employed weigh 3 tons 12 cwts. when empty, and 7 tons 1 cwt. when loaded. They are mounted on 4 cast iron wheels, 30 inches in diameter, keyed fast on the axles, and have outside bearing brasses, but neither buffer, draw, nor bearing springs. The motive power consists of locomotive engines weighing from 14 to 16 tons each, exclusive of tender. The rate of hauling, ranges from 10 to 16 miles an hour.

This line was originally laid in a very temporary manner, with bridge rails 2.5 inches high, 2 inches wide at the top or bearing part, and 6 inches at the foot; and weighing 56 lbs. per yard lineal. They were fastened by spikes through the flanches to cross sleepers, 6 inches by 4 inches, by 6 feet long, at intervals of 4 feet. The ballasting consisted of the clay and peaty soil excavated from the side drains, and distributed in a layer one foot thick under the sleepers.

After two years wear, with the engines and wagons described above, the original rails were laminated to an extent that rendered their renewal a matter of necessity. The gross traffic that passed over them during that period, amounted to 1,822,800 tons. Had these rails been supported by larger sleepers at shorter intervals, and these sleepers packed up by proper ballasting, they would have stood the wear and tear of from twice or three times the above quantity of traffic.

CASE 2. The railroad previously described, was relaid with T rails 3.75 inches high, 2.5 inches wide at the head, and 3.5 inches broad at the foot; and they weighed 63 pounds per lineal yard. The small sleepers were replaced by others, averaging 9 inches wide, by 9 feet long, at the reduced distance of 3 feet apart from centre to centre. The rails were also supported on shallow cast iron chairs, which were spiked to the sleepers, and the clay ballasting was strengthened by the addition of a thick layer of broken stones. The new rails with the altered mode of laying, have now been in use ten years, during which period the gross traffic over them has been 9,710,000 tons.

The height of these rails when new, was 3.75 inches, as previously stated, but by wear and abrasion from the rolling of the above weight, their height has been reduced to 3.63 inches. Taken collectively, these rails have endured very well, and with the exception of a very few crushed and bruised bars, which will require immediate renewal, they will, probably, continue fit for the traffic for at least three years again. Hence their duration may be estimated as equal to the movement of 12,600,000 tons.

To show the ill effects which must result from inattention to the state of the sleepers, at different places on the line, a sleeper end was permitted to remain without proper support. After the lapse of a few days, the rails immediately over the slackened sleepers, were found crushed and flattened for a length of 6 or 7 inches, so as to reduce the depth of the bar from 3.63 to 3.2 inch-

es. Similar results followed, when the distance between any two sleepers was increased to more than 4.5 feet; thus showing the necessity of having, under the rails, a firm and rigid support at very short intervals, to prevent as far as possible all injurious deflexion.

In those rails which have broken down, either from lamination, or during the foregoing experiments, the impropriety of using any other than puddled iron in the top surface of the rail was fully displayed. These rail bars were manufactured from piles of the ordinary quality and description, with a top plate of the so-called "best iron," one inch in thickness. This plate in the course of rolling was reduced in thickness, to .16 of an inch in the finished bar. Now, all the lamination which has yet been discovered, has occurred with this superficial coating of "best iron," which has often peeled off, in long narrow strips or splinters, of several feet in length.

Case 3. Mineral railroad, consisting of a steep incline plane of the 4 feet 8.5 inches guage, with a double track of rails, each 480 yards long, and falling 6.7 feet per chain. The direction of the traffic being downwards, this portion is worked by the gravity of the descending full wagons, which are made to draw up the empties, by means of ropes, working over rope rolls and friction drums, revolving on gudgeons at the incline top. The rails were of the bridge pattern, 2.5 inches high, 2 inches wide at the top, 6 inches broad at the foot, and weighed 56 pounds per yard. They were supported on flat cast metal chairs, which were spiked to transverse sleepers of 8 inches wide, by 8 feet long, placed 3 feet apart. Under the sleepers, there was a thin stratum of clayey soil as ballast.

The wagons described in case 1, roll over this section, also, at velocities averaging 12 miles per hour. The rails on this section were in use for eleven years, during which time the traffic over them amounted to 8,087,000 tons, equal to 4,043,500 tons over each track. The injury which results to the rails from the absence of adequate support under the sleepers was manifest in this case, and, undoubtedly, was the means of shortening their duration fully one half.

While forming another mineral railroad, crossing under this section, it became necessary to evacuate an opening, 10 yards wide, over which the rails were carried by four pieces of pine timber; one being placed under the centre of each rail bar. The deflexion of the beams by the passing of the loaded wagons, was from 2.5 to 3 inches, and from this cause alone, the whole of the rails on these pine stringers were battered and laminated so as to require renewal in the short space of two months, and after they had borne a traffic of no more than 61,300 tons.

Case 4. Mineral railroad, on a dead level throughout, consisting of a single track of bridge rails, the same as those described

in case 1, but spiked directly to sleepers, averaging 6 inches wide, by 6.5 feet long, placed 3 feet apart on broken limestone, as ballasting. The wagons previously described, work over this section also, but the motive power being horses, the rate of travelling rarely exceeds three miles an hour. The rails on this section have now been in use eleven years, have borne a traffic of nearly 4,900,000 tons, and with the renewal of the wood-work of the line, will probably last for a similar period, and for the passage of an equal quantity of traffic. Their duration may, therefore, be assumed to be equal to the transport of 9,800,000 tons.

From the foregoing examples it will be seen, that while bridge rails, weighing 56 pounds per yard, were destroyed with the passage of 1,822,800 tons, hauled at a velocity of 12 to 16 miles an hour, by locomotive engines, weighing from 14 to 16 tons each; with the same wagons, but at the reduced speed of 12 miles an hour, they have stood under the passage of 4,043,500 tons; and with the same wagons, but at the still further reduced speed of 3 miles an hour, they have stood the wear and tear from the passage of 4,900,000 tons, without material injury.

Case 5. Railroad for the conveyance of coal, consisting of an inclined plane, falling 7 inches per yard, forming a double track of rails of the 4 feet 8.5 inches guage, 400 yards long, and worked by stationary steam power at top, through the medium of ropes and drums. The rails are of the inverted U pattern, or Evans' patent, weight 90 lbs. per yard, were 3.4 inches high, 2.74 inches wide at the head, 4 inches wide at the foot, rolled in lengths of 15 feet, and supported at intervals of 3.5 feet by cast iron chairs resting on massive blocks of limestone.

Each track of rails is traversed by a single wagon, mounted on four cast iron wheels, 2 feet diameter, keyed on wrought iron axles, and revolving in brass-fitted plummer blocks bolted to the frame work of the wagon. The weight of the wagon when empty is 7 tons 2 cwts., when full, 13 tons 16 cwts., and it is drawn at an average speed of 8 miles an hour.

These rails have now been in use seventeen years, and the gross traffic which has passed up and down the plane, amounts to 11,016,000 tons, or 5,508,000 tons over each track. The result of this traffic has been to reduce the height of the rails from wear and abrasion, from 3.4 to 3.26 inches. In other respects they are in good condition, and will probably sustain a further traffic of 3,500,000 tons, making their duration equal to 8,000,000 tons.

Case 6. Railroad for the conveyance of limestone, a single track 2½ miles long, worked by horse power. The rails were of the fish-bellied section, 5 inches high, 2 inches wide at the head, and .75 inches thickness of centre web, weighed 55 pounds per yard, and were laid in cast iron chairs, resting at intervals of 3.5 feet on limestone blocks of from 2½ to 3 cwts. each.

The wagons, which were made wholly of wrought or cast iron, weighed, when light, 1 ton 19 cwts., and when loaded 8 tons 10 cwts. each. The wheels were 2 feet 6 inches in diameter, and turned loosely on the axles, which were bolted to the under side of the carriage.

These rails stood for nine years, with an average annual traffic of 180,960 tons, or a gross total of 1,628,640 tons, when they were replaced by stronger bars.

CASE 7. Railroad, consisting of an inclined plane, with a double track of rails raising 6.7 feet per chain forward. Rails of the bridge pattern, weighing 56 pounds per yard, 2.375 inches high, 2.125 inches wide at head, and 5.625 inches at the foot; spiked directly to cross sleepers 9 inches wide, by 9 feet long, at distances of 3 feet 3 inches apart. The sleepers repose on a thick deposit of broken scoria, from the blast furnaces in the neighborhood, which is found to be an excellent material for ballasting the permanent way of railroads.

The wagons running on this road are of wrought iron, mounted on 4 cast iron wheels, 30 inches in diameter, turning loosely on their axles, and are without springs of any kind. They weigh when light, 1 ton 8 cwts., and when loaded, 4 tons 16 cwts.; and are drawn by stationary steam power acting through drums and chains, at an average speed of 6 miles an hour.

These rails have been in use thirteen years, and appear but very little the worse for the traffic which has passed over them. This has amounted to a gross weight of 7,840,000 tons, or 3,920,000 over each track. Their duration may be fairly estimated at twice this weight, or 7,840,000 tons over each track of rails.

CASE 8. Railroads for the conveyance of goods, metals and minerals, consisting of a single track of rails of the bridge pattern, weighing 75 pounds per yard, 2.5 inches high, 2 inches wide at head, and 6 inches at base, laid in shallow cast iron chairs, which are spiked to sleepers 9 inches wide, by 7 feet long, placed at distances of 3.5 feet apart.

The wagons travelling over this road are of various patterns, and are, with a few exceptions, devoid of springs. Their weight, when empty, varies from 26 to 63 cwts., and when loaded, from 6 to 11 tons. The speed at which they are drawn varies, also, from 3 miles an hour, the speed of those drawn by horses, to 12 miles an hour, for those drawn by steam locomotive engines.

These rails have had the wear and tear from the passage of 4,783,000 tons of miscellaneous traffic, but, from their damaged condition, we cannot estimate their duration at more than 5,500,000 tons.

CASE 9. Railroad for the conveyance of coal, consisting of a single track of parallel rails, weighing 40 pounds per yard, 3.87 inches high, 1.87 inches wide at the head, 1.2 inches wide at

base, with centre web .56 inch thick, laid in cast iron chairs pegged to stone blocks, weighing from 4 to 6 cwts. each, and placed at an average distance of 3 feet apart from centre to centre.

The wagons running on this road are drawn by horses, at an average speed of 4 miles per hour, and are mounted on four cast iron wheels, 28 inches in diameter, turning loosely on their axles, which are bolted to the wrought iron frame of the wagon. They weigh, when empty, 3 tons, and when loaded, 5 tons 17 cwts.

The gross traffic over this line has amounted, during the 13 years which it has been open, to 8,626,000 tons, and it now remains in a good working condition. The duration of these rails may, therefore, be estimated at about 15,000,000 tons.

CASE 10. Taff Vale Railroad, for the conveyance of passengers, metals, minerals, and general merchandise, between Cardiff and Merthyr Tydfil. Upper section consisting of a single track of parallel rails of the single head form, weighing 50 pounds per yard, 4.5 inches high, 2.2 inches wide at head, 2 inches width of lower web, and .66 inch thickness of centre rib or web, supported at intervals of 3 feet by chairs bolted to cross sleepers 10 inches wide by 9 feet long. The ballasting under the sleepers consists of a thick stratum of broken cinders.

The wagons and carriages running on this road, vary considerably in their weight—from 2 tons 10 cwts. to 4 tons 10 cwts. when light, and from 8 tons to 12 tons when loaded. They are furnished with wrought iron wheels and tyres, bearing springs and friction brakes, and the passenger carriages have buffer and draw springs. The locomotive engines employed weigh about 20 tons, exclusive of tenders, and work at speeds varying from 15 miles per hour, for slow mineral trains, to 30 miles an hour for passengers.

These rails have been in use nearly 13 years, and from the most careful computations, the traffic over them has been 5,400,000 tons. At the crossings and portions of the line where a considerable braking power is applied, their depth is reduced, by abrasion, to 4.4 inches, but in all other respects, these rails are generally sound. Their duration may be estimated as equal to the rolling of 10,000,000 tons.

CASE 11. Taff Vale Railroad—the down-line from the Aberdare junction to Cardiff. Length of the line, 14 miles, and falls at the rate of 15 feet per mile. Rails of the parallel double headed section; depth, 5 inches; width of head and foot, 2.5 inches; centre web, .75 inch thick; weight, 72 lbs. per yard. They are supported at intervals of 2 feet 9 inches by cast iron chairs firmly bolted to cross sleepers, 10 inches wide by 9 feet long. In all other respects, the formation of this road is similar to that of the upper section near Merthyr Tydfil.

The carriages and engines last described, work on this section also, and at similar speeds. It is traversed daily by 3 passenger, 1 mail, and numerous luggage, metal, mineral, and merchandise trains. The passenger trains average 96 tons gross each, but the mineral and other trains sometimes exceed 1000 tons in weight.

From the annual traffic reports of this company, we find that in the eight years that these rails have been laid, the gross traffic which has rolled over them amounts to 20,516,000 tons. Although this weight has caused considerable lamination and abrasion at the stations and on the sharpest curves, these rails are now in fair working order, and with attention to the sleepers and ballasting, they will last for the conveyance of as much more. Hence, their duration may be estimated as equal to the rolling of 41,000,000 tons.

Case 12. Taff Vale Railroad—the up-line from the shipping port of Cardiff to the Aberdare junction. This line is of the same length, and is similar in its construction to the down line, with which it runs parallel throughout. It is traversed, also, by the same engines and carriages, but the coal and coke wagons pass over this line empty.

The rails are of the same date as those on the down line, and the gross weight which has rolled over them, amounts to 11,200,000 tons. Their general condition is very similar to those in the down line; and their duration may be estimated as equal to the passage of an additional weight of 11,200,000 tons, or a gross total of 22,400,000 tons. The greater weight traversing the down line is owing to the large quantities of coal sent down for shipment; the wagons used in the conveyance of which, return empty over the up line to the collieries.

The rails on both sections having suffered nearly alike in lamination and abrasion, although one has sustained little more than half the rolling of the other, is accounted for by the circumstance of the gradient being just sufficient to enable the engines and loaded wagons to roll down the one line, while on the other the ascent with 90 or 100 empty wagons is accomplished with difficulty by engines having 18 inch cylinders. The abrasion and injury to the rails by the slipping of the engine wheels in ascending gradients, is probably equal to, if it does not exceed, that from the rolling of the traffic.

Case 13. Railroad for the conveyance of minerals to the Hirwain Iron Works, consisting of a single track, 3 miles long, of the 4 feet 8.5 inch gauge. Rails, of a parallel single head form, 4.25 inches deep, 2.5 inches wide at the head, and .75 inch thickness of centre web. They weigh 46 pounds per yard, and are screwed fast to single cheek chairs, on massive stone blocks every 4 feet. The ballasting consists of blast furnace cinders, and dust from the coke yard.

The carriages are constructed of wrought and cast iron frames, and are mounted on 4 cast iron wheels, 82 inches diameter, turning loosely on axles bolted firmly to the carriage frame. They weigh when light 2 tons 5 cwts., and when loaded, 5 tons, but are unprovided with any springs. The locomotive engines weigh 10 tons each when in running order, and propel the loaded carriages at an average speed of 10 miles an hour.

This road has been laid with these rails about 4 years. The gross weight which has passed over it in that time amounts to 1,055,000 tons. On carefully examining the state of the rails after this traffic, 23 per cent. were found laminated to an extent rendering their immediate replacement by sound rails indispensable; while the others cannot, under existing circumstances, last more than 2 years again. The duration, then, of the rails on this road may be estimated as equal to the passage of 1,318,000 tons, or considerably less than either of the previous examples.

In reference to the foregoing examples of the duration of railway bars under different conditions of laying and working, we may remark that in every instance where, in the construction of the permanent way, sufficient solidity has not been obtained by the employment of adequate sleepers, the destruction of the rails has been most rapid. This was the result with cases 1 and 6, and the effects are visible in 3, 4, 5 and 8. The greater duration of 11 and 12 over the others, must be ascribed to the use of heavy rails, wagons, and carriages with bearing springs, and a well constructed and carefully maintained permanent way. No. 12 is a very favorable instance of durability—probably equal to any ever laid, which has principally resulted from the very favorable grade of the line. No. 10, with heavier rails, would have equalled No. 11, as the conditions are otherwise similar. The absence of bearing springs to all the wagons, except those in cases 10, 11, and 12, must also have had a very prejudical effect on the rails and greatly lessened their duration. In case 6, the rails were too weak, and the support unequal to the heavy wagons employed. Case 9, with heavier blacks and lighter wagons, is a very favorable specimen of a mineral railroad. Case 13, shows the most unfavorable results of the whole number detailed, but when the very inferior quality of the metal used and the defective nature of the fastening employed is fully considered, a different result could scarcely be expected.

In the tabular statement of the duration of the rails, it is supposed that the cost of labor and materials in replacing unsound bars and the ultimate expenses incidental to the entire renewal of the rails, when worn out, will be equivalent to the value of the old metal obtained. This is found to agree very nearly with the results obtained in practice.

We have in our possession, similar notes respecting the duration of cast iron rails, of which numerous examples may be seen

at or in the neighborhood of Merthyr Tydfil; but the general abandonment of this material for that of wrought iron, would cause such notes to be of little value if published.

Tabular Statement of the Duration of Iron Railroad Bars.

Number of case or example.	Weight of rail (in pounds) per yard.	Depth of rail in inches.	Bearing surface presented by sleepers for each lineal foot of track, in superficial feet.	Greatest weight rolling on 4 wheels, in tons.	Greatest weight on a foot lineal of track, in tons.	Velocity of trains in miles per hour.	Motive power employed.	Gross traffic over a single track of rails before renewal, in tons.	Weight of rails per mile for a single track, in tons.	Cost of rails per mile, estimated at 50 dollars per ton.	Number of tons carried over 1 mile of road for each dollar's worth of iron consumed.
1	56	2.5	.75	16	2.7	16	Locomotive,	1,822,800	88	4400	414
2	63	3.75	2.25	16	2.7	16	"	12,000,000	99	4950	2424
3	56	2.5	1.75	7.	1.2	12	Gravity,	4,043,500	88	4400	919
4	56	2.5	1.1	7.	1.2	3	Horses,	9,800,000	88	4400	2227
5	90	3.4	1.7	14	2.	8	Stationary,	8,000,000	142	7100	1126
6	55	5.	1.1	8.5	2.2	3	Horses,	1,628,640	86	4300	378
7	56	2.37	2.1	4.8	1.5	6	Stationary,	7,840,000	88	4400	1781
8	75	2.5	1.5	11.	2.4	12	Locomotive,	5,500,000	117	5850	940
9	40	3.87	2.5	5.9	1.3	4	Horses,	15,000,000	63	3150	4126
10	50	4.5	2.5	16	2.8	30	Locomotive,	10,000,000	78	3900	2564
11	72	5.	2.7	16	2.8	30	"	41,000,000	113	5650	7256
12	72	5.	2.7	16	2.8	30	"	22,400,000	113	5650	3964
13	46	4.25	2.	10	2.1	10	"	1,318,000	72	3600	363

ART. V.—THE VENTILATION OF MINES AND COLLIERIES.* By John Philips, F. R. S.

THE next step in ventilating collieries, consists in substituting for this temporary fire-pan, a permanent furnace near the base of the shaft. *d.* is the downcast shaft, *u.* the upcast-shaft. The air which descends *d.* is prevented from passing to *u*, by any of the direct or indirect passages which exist by double doors, more or less carefully secured, and carried away to the main gate, bord-gates, and working faces, by the water-level or some other channel. It is brought back from the works by the return drift to the front of the furnace. It passes through this furnace and up the inclined flue to the upcast-shaft, thereby heating that shaft 10°, 20°, 40°, and more, above the temperature of the downcast-

*** Continued from page 15, Vol. IV. No. 1.**

shaft, according to the power of the furnace. In the practical working out of this plan we perceive many variations. There is obviously some mechanical advantage to be gained for the aerial current by making the pumping or engine pit the downcast-shaft, and placing the furnace near the base of the upcast-shaft. Yet this is not seldom departed from, because of the inconvenience which attends the operation of winding and the wear of ropes, &c., in a hot upcast-shaft. Wire ropes are preferable in such a shaft; they require large sheave

In several collieries the underground is found dry, or nearly so; engine-pumps are not required; both the adjacent pits are winding-pits; both are somewhat bathed and cooled by dripping of water, and one is heated by a furnace.

In other cases a separate upcast-shaft is placed far up the rise of the strata; and a pair of downcast winding-shafts to the deep.

This arrangement (if not impeded by faults) may be such as to allow of the constantly upward movement (or at least to avoid any far downward movement) of the heated air; an advantage which cannot be obtained by a pair of adjacent pits, one downcast, the other upcast.

When the upcast-shaft is placed far to the rise, the removal of successive faces of work is performed without lengthening the air course. In some cases, as at Handley Wood, there are several upcast-shafts, each with a furnace on the rise, sunk to small depths, having a regulated communication with the downcast-shafts in the deep. By this means there is a certain constant drain on the effluent gases, and an increased measure of security against the dangerous accumulation of them.

As all the air from the mine goes down one, or one set of shafts, and up another, or another set of shafts, an accurate measure of the currents in either set would determine the flow of air through the mine. But in these pits the circumstances are not favorable to an exact measurement. The frequent use of the shafts in raising up and letting down the corves, boxes, or trams, sometimes by a chair or stage, and the recurring action of the pump derange the regularity of the currents; it is, therefore, best to measure the flow of air in the main gate or main return, if we wish to know the total quantity which enters and leaves the mine; and at the working-bank, if we wish to ascertain what is the force of that wall of air on which, as already shown, the safety of long work depends. The process of measuring the aerial currents has been but little followed in Derbyshire; even estimates by the candle are rarely found recorded. The ingenious anenometer of Mr. Biram is known and occasionally employed. From the small number of observations which I have yet made, or received on the air currents in the collieries and iron-stone mines of Derbyshire, I select a few for the purpose of showing—1. That as large currents can be made to pass through these collieries, as through

those on the Tyne. 2. That very much smaller currents are generally thought to be sufficient for smaller works. 3. The quantity of air usually carried by working banks. 4. The effect of accidental ventilation.

Total quantity of air drawn by furnace action through—		
1.—Speedwell Colliery (Stavely Works) .	40,000	cubic feet per minute.
Hollingwood Colliery	85,0C0	"
2.—Portland Colliery (Butterley Work) .	12,668	"
No. 9 Pit, one of several pits.		
Brand's Pit, one of several pits . .	7,481	"
Quantity of air passing by working-banks—		
3—Hollingwood Colliery	4,000	"
Duckmanton, new foundation . .	8,600	"
4.—On a face of Ironstone-working (Butterley)	1,386	"
On a face of coal in the same pit . .	456	"

From such examples it must appear obvious, that in respect of quantity of air passing through the collieries in Derbyshire there is much inequality, and yet nothing could be more erroneous than the inference that the pits with a small supply of air are necessarily unsafe. This can only be judged of after a thorough investigation of the physical conditions and artificial arrangements. To a certain extent it must be allowed that the supply is intended to be proportional to the extent of the workings, the number of men, horses and lights, and the want of air which these circumstances occasion. An engine-plane underground makes a great difference in all the arrangements of the works, and its fire flue is a ventilating power of considerable efficacy. In general, the number of men and boys employed, or the daily delivery of coals in tons, may be taken as an index of the quantity of air per minute required for ventilation. In very few collieries of Derbyshire is the quantity of air supplied per man (counting only the holders) equal to the average quantity which passes by a hewer in Durham and Northumberland.

On the system of ventilation of small fields of work by frequent shafts, which is practised in Derbyshire, it may be remarked, as a disadvantage which should be avoided in all new arrangements, the passage of the heated air up the pumping-shaft, which, by reason of its tendency to wetness and coldness, is generally better fitted for a downcast than for an upcast shaft.

The employment of the winding-pit for the upcast is preferable; but in this case wire-ropes are needful, and upon the whole the best arrangement of all is to have separate air-shafts (often called cupolas), which may often be advantageously placed on the rise of the beds. The return air courses by which the foul air is brought to the upcast-shaft are, in some cases, much too small in area, and offer too great an impediment to the free movement of the air. Furnaces placed at the top of the shaft cannot be so effective as those at the bottom, but there may be cases in practice which may be sufficiently met by such an arrangement.

Whatever be the amount of ventilating power, its practical effect in the mine is mainly dependent on the skill with which the air passages are proportioned and managed; in fact, on the pitmanship, to use an expression of the late Mr. Buddle.

Another circumstance, by no means without influence on the actual circulation of air through the galleries of the mine, is the mechanical condition of the masses through which the galleries pass. In a very simple working the air course every where goes along between a face of solid coal, and a face of packed and fallen materials (technically the gob, gobbing, or goaf), except along the return drift, where it is sometimes inclosed in solid coal. In this case some escape of air happens across the gobbing, which retains always some vacancies, more or less pervious to the air. In consequence, the total volume of air really in forward motion at the origin of the bordgate, does not reach the origin of the return, a part being sucked through the gobbing, to reappear more or less loaded with the air which would else have remained stationary in the gobbing until some fall therein might puff it out. In consequence of these circumstances, the air at the extremity of the workings begins to be loaded with some impurity by reason of its comparative slowness, and the air in the return still more so by admixture with the outflowing gobbing air.

In reference to this subject, it seems desirable that both the main air channels leading from the downcast shaft to the workings, and from the workings to the upcast shaft, should be kept for as great a length as possible in solid ground, or when this fails within brick walls, in order that the current may retain as much as possible of its activity along the working faces. This condition is to a small extent secured in many collieries in Derbyshire by the practice of leaving whole coal about the base of the shafts; the main working gate (especially when it coincides with the water level) is also sometimes inclosed by a rib of coal through which the bordgates are driven; but it is far more rare to find in any colliery the workings so arranged as to secure the air from traversing any old workings, by taking it round the whole coal, commencing the workings at the extremity, and bringing them continually homeward to the pit. To this practice, which seems safer than the ordinary mode, two objections are made: first, that it is expensive to the coal worker, requiring a further and unnecessary outlay of capital in headings after the sinking of the pits, and a delay in opening the works; and secondly, that the roads to be thus maintained for a long period in solid ground, are more costly than in gobbing, the heaving and the walls rating or chipping and falling under the pressure. This objection, however, applies still more to the case of a road which has solid on one side, and gobbing on the other.

DISCIPLINE OF THE MINE.

The collieries of Derbyshire which I examined were, for the most part, well illustrated by plans and sections, the succession of the strata of coal and iron-stone being in general well, and indeed familiarly known. The extent of old workings, and the direction of faults (points of great value in this district), were tolerably ascertained. The plans were sometimes found brought up to date by continual attention, in other cases completed, from time to time, with reference to payments of royalty, or particular extensions and modifications of workings.

The extreme simplicity of long work as compared to the post and stall, or whole and pillar working of the northern collieries, no less than the comparative smallness of the Derbyshire workings, reduces the management of the mine to a point much below that anxious, earnest, and hourly attention which is bestowed on the deep and fiery mines of the Tyne and Wear. Here are no distinctions of lamp districts and candle districts, no wastes closed by iron gates, no miles of air course to be maintained and inspected beyond the range of the workings. The ground once passed is in a great measure abandoned; sometimes a little refreshed by small streams of air stealing across the gob, but generally disregarded, except along the edges where the men work and travel. The inspection of these edges, and of the gob to a small extent within, is effected for the most part by candles cautiously introduced by the under-ground managers, or lamps which are capable of being unscrewed, and used as tests in the same way as candles.

The management of extensive collieries is sometimes intrusted to an officer who represents the resident, or under-viewer of Newcastle, and who reports to the superintending viewer or mining engineer. The actual direction of a given colliery is in the hands of an overman, or underground bailiff, who is assisted by persons (corporals), corresponding to the deputy overmen of the north, and others (night-men, gate-packers), who represent the wastemen. These latter examine daily the state of the air courses, regulate the ventilation, and keep up the roads by packing. In the daytime the corporal precedes the men who first enter, attends to the working, and looks after the furnace, when there is one. The Derbyshire coal does not easily go out, and this renders the furnace work much lighter than in the north of England; twice mended in 12 hours the fire will retain its action, and being well raked on Saturday night, will be found effective when stirred early on Monday morning. Lamps are so rarely used in Derbyshire collieries that it is needless to speak of regulations concerning them. Candles are not to be taken rashly into the gobbing; accidents to a limited extent have occurred from this cause, in

many instances, but no considerable explosion. In some collieries precautions are taken against the evolution of sulphur (fire damp), by drilling upward into the roof. At Pinxton this process yielded gas at every hole. The same was once observed at Duckmanton. The gas which is yielded by the fresh coal always makes itself heard, and its quantity augments toward faults.

The pits are frequently furnished with guides; wire ropes are beginning to be common; but the flat hempen rope is still general, and is "clipped" (mended by iron hinges) something too often for safety.

GENERAL REMARKS.

There has been, I believe, no explosion of importance in the collieries of Derbyshire for many years; and only a few cases of burnings suffered by individuals whose negligence brought their candles within the range of the sulphur. Choke-damp is more injurious, but loss of life is rare from this cause also.

Collieries thus circumstanced may, perhaps, not be regarded as specially demanding official interference. They may, however, be greatly benefited by a careful and suggestive inspection, because although the processes now in use, and the experience and knowledge of the managers may be sufficient for the present need, they appear sometimes unequal to contend with greater depths, and greater dangers. There is no reason to expect that an explosion in the banks of long work would be less destructive than in the pillar working of the north to which it is comparable in some respects; or that an explosion in the straight work of Derbyshire would be less injurious than in the whole working of Durham and Northumberland. There can be no doubt that the currents of air ought even now to be greater than what are generally found; there is no doubt they must be increased many times, if the beds are to be reached by pits a few miles east of the present establishments. Then most probably the Davy lamp, now a mere ornament in a few of the coal-offices, will be in careful use, under strict and responsible regulation, and before that happens it will be well to communicate the knowledge which renders it safe. The working colliers and ironstone miners of Derbyshire share to a considerable extent the intelligence and spirit of their brethren in the lead mining district, and will often excite surprise by the breadth and exactness of their local knowledge of stratification, faults, and old colliery workings. The subordinate officers of the mines are often men with whom it is both pleasing and profitable to converse. Several of the great iron masters manifest activity and benevolence, in building and supporting schools adapted to the large populations dependent on their works; and thus all things concur to render it probable that schools suited to the various grades of mining employment would be a welcome gift to the district.

YORKSHIRE.

The Yorkshire coal-field contains the same beds of coal as the Derbyshire field; allowance being made for the local variations which always occur, and for the unequal areas covered by different seams. The Top hard of Derbyshire, one of the upper valuable seams, is the Thick or Barnsley bed of Yorkshire, and similarly placed in the mines; the Black shale coal of Derbyshire is the Silkstone bed of Yorkshire; while between them range in each district many ironstone bands and variable coals; and below them is the Kilburn of Derbyshire, and the Black bed, and better bed of Low moor in Yorkshire.

The Yorkshire coals have in general an easier and more constant dip to the east than those of Derbyshire; they are not so remarkably heaved into anticlinals, but there is one great fold of the strata on the line of the valley of the Dun. There is more sandstone rock in the Yorkshire coal section than in that of Derbyshire, and the total thickness of coal measures is somewhat greater, without, however, a corresponding increase in the quantity of coal. Faults are numerous, but thin dikes totally unknown in the Yorkshire, as also in the Derbyshire coal-field. Lead ore has been found in the coal on lines of fault, and zinc ore in clefts of ironstone.

The Yorkshire collieries are at present very generally worked by methods which are more or less analogous to those followed in Derbyshire, the coal being generally got in banks. But while in Derbyshire only two essentially distinct varieties of this system appear, viz., the working outward or from the pit, by which the enormous area of gob spreads toward the extremities, and includes or adjoins many of the roads; and the working inwards, or toward the pit, by which the gob is continually left behind, and abandoned by the roads; these conditions are, in Yorkshire, variously complicated with peculiarities, of which some are derived from an earlier system, and others are indicative of the transition state of opinion and practice, which give to this great coal-field at this time a high degree of interest in questions of ventilation and the safety of miners.

Perhaps the oldest system of underground working in Yorkshire is that which was extensively practised, but has been abandoned, in the collieries of Earl Fitzwilliam, near Wentwork; a system to which the name of narrow work may be applied. In this method parallel bordgates run across the cleat or facings, at intervals of about 90 yards; and between these, a series of 8 or 10 bords, about 8 yards wide, except at the entrance, which was narrowed; between these bords, ribs of solid coal were left one yard in width, except at the entrance of the bords, where an angular mass was allowed to remain. The sides of the bordgates were supported by solid ribs (posts) of coal.

A variation of this process occurs at Middleton Colliery near Leeds. In this arrangement parallel (double) bord-gates, &c., are driven at regular distances (110 yards) across the facings of the coal; and between these banks are worked 10 yards in length by parallel bords, which are separated by posts or ribs of coal one yard wide, both being crossed at intervals of 12 yards by endings (endways, drifts, or gates) which serve successively to bring out the coal from the banks. The air circulates along the face of the working, and in particular instances drains off through the gob into the return, the roof, on account of its firmness, falling in large angular masses, which leave many vacuities.

The method in common use about Barnsley is essentially a sort of contracted long work; the bord-gates being kept between walls, pillars, or posts of solid coal, while, between them the banks, 20, 30, or more yards in length, are excavated to the rise, so as to leave long spaces of gob continually extending toward the outcrop. The pillars are afterwards removed in the contrary direction (*i. e.*, brought homeward), and the whole ground falls.

In Ardsley Main this system is so managed, that very wide pillars of coal, are left to guard the bord-gates. These occupy 40 yards, while the banks are 30 yards long. The banks are worked in two portions, continuous lines of packing in the middle of the space, as well as along the sides, being resorted to for moderating the heavy roof-falls; or, instead of that method, a rib of coal is left in the middle, thirled at intervals for air, and the convenience of working.

In the four methods now mentioned, the air passages are single, or in pairs, separated by considerable thicknesses of coal. The workings next to be mentioned differ in this respect. At Thorpe Hall, near Leeds, the air passages are driven so near together that only a thin wall of coal, half a yard in thickness, separates them. This wall is thirled for air at short intervals, in the progress of driving, the thirlings being afterwards stopped. Thus two closely approximate channels are formed, the intake air going up one, and the return air coming back by the other. The channels being small the current is not large, but its velocity is about five feet in a second, and it passes pure to the working face, which in this colliery is brought backward. The air does not traverse the gob, but works only between it and the banks, being every where else in solid coal. The drifts in solid coal or rock are called straight-work in Yorkshire. In this colliery an explosion occurred, owing to the blocking up of straight-work, through the negligence of two men, who lost their lives in consequence. To some accidents of this nature, this very narrow style of work must be occasionally liable.

The plan of works at Emroyd (Flockton) Colliery, is much like what has been just noticed; double drifts being driven in solid coal to win and bring back banks, so that the gob is left

behind, and never again traversed by roads or air courses. But the approximate drifts are not employed as at Thorpe Hall. They both carry air in one direction, and communicate frequently through the little rib of coal which is from one to three yards in breadth. In Silkstone Colliery about four yards of coal separate the drifts, and the air is taken along one of them only.

The uncommon variety of working processes in Yorkshire, is not altogether explained by the variety of physical conditions under which the coal is worked. The depths vary indeed from almost the surface to 300 yards; beds are worked as thin as 18 inches, and as thick as 10 feet, with roofs of sandstone or shale, and with underclay (spafen), of fire-clay or ganister; but it is not so much these circumstances as the locality, and the point of progress and improvement in which a colliery is placed, which determine the mode of working. True longwork seems to have come from Derbyshire and other midland districts, where it perhaps originated in natural conditions; but another form of working in narrower banks seems to be of higher antiquity in Yorkshire, and to have been derived from another source. It is accompanied about Bradford by a set of technical terms not found in Derbyshire, as neither one nor the other set would be intelligible on the Tyne.*

The extrication of gas in the collieries of Yorkshire follows the usual rule; it flows freely from the ends of the coal, which are continually laid open in the process of daily work; it flows with a dangerous facility, on particular occasions, from the sides of the throws or galls, which in certain districts are very abundant; but there are rarely any blowers, or puffs of gas. Under these circumstances strong ventilation, and a judicious use of the lamp, ought to produce safety if the fields be well penetrated by exploring drifts, amply supplied with air, which does not afterwards pass by any workings. In Ardsley Main these cautions are now observed systematically; the air circulating in the mine is frequently and correctly measured; lamps are constantly in careful use, and the gob is periodically inspected. I found no sensible trace of gas in the gob there, but the exploring drifts were yielding it in as great plenty as we commonly find it in such cases on the Tyne.

* The operation of undercutting the coal is called kerving (carving) on the Tyne, holing in Derbyshire, cutting and baring in the west of Yorkshire; the short passages which are made at intervals to connect approximate air courses, are called holings on the Tyne, thurlings in Derbyshire, and sometimes slits in Yorkshire; faults have this name in Derbyshire, but are called galls and throws in the west of Yorkshire, and slip dykes, troubles or hitches in Durham and Northumberland. To cut the end of a bank, is the Derbyshire phrase, for the nicking of the north, and the cheeking of Bradford.

ARRANGEMENTS FOR VENTILATION.

There is a general conformity through Yorkshire, Derbyshire, and Nottinghamshire in the desire, and in the practice of carrying all the air in one stream by the banks or working faces. In small collieries this is almost invariably done, and in larger establishments, the air from one downcast shaft is seldom split above once; in some cases the currents from two downcasts are united into one intake channel, and not afterwards divided. This circumstance, coupled with the system of separated districts of gob, tends to lengthen the air courses; but this bad effect, whereby the air current is retarded, is in a great degree counterbalanced by the frequency of shafts, the small fields of work, and the insulation of the districts. Ventilation by shafts, which by some persons is thought to be the grand cure for explosions, is exhibited in a complete and successful form in the extremely thin but valuable beds at Low Moor, where the shafts are in pairs, one pair about a quarter of a mile distant from another, one of the approximate shafts being a small upcast (cupola) for air only, the other a larger downcast for winding. In the Old Silkstone Colliery the air travels three miles underground before reaching the cupola of Husker Pit, but this is a distance much beyond the average in Yorkshire workings.

The pure air enters Middleton Colliery by a large adit; some air enters Old Silkstone Colliery by an adit; but this is now comparatively a rare arrangement. I have not seen a shaft bratticed or divided for the air to descend one side and ascend the other. More commonly there are several downcast shafts, which deliver their supplies to channels which communicate underground, and one or more upcasts. This happens sometimes from the running together of works originally separate.

VENTILATION.

The ventilation force employed in the Yorkshire Collieries is, in its highest form, derived from a powerful furnace, offering no mean rivalry in construction and effect to the strong fires of the north. In its lowest form it is a mere coal lamp; *i. e.*, mass of coal ignited in an iron grate, placed at the foot of the upcast shaft in a little recess. Between these extremes are many variations generally characterized by feebleness of air, and contracted or impeded passages to it. This not seldom arises from an unwillingness to pass the return air through or over the furnace—cases of danger having arisen from this cause in mines with feeble and lengthened currents. On this account the furnace is sometimes fed with pure air, and its drift enters the upcast shaft separately from that which brings the air from the mine. Upon the

whole the furnace action in the collieries of Yorkshire may be much and easily augmented, and I think it ought to be.

An experiment made in my presence at Tordoff Colliery (Low Moor), shows how important in ventilation is a constant attendance on the furnace. The quantity of air measured in the intake and return by Biram's anemometer, gave an average of 5,239 cubic feet in a minute; the fire was then strongly stirred, and the quantity measured soon after in the intake and return gave, on an average, 7,017 cubic feet in a minute.

It will be difficult in some of these collieries to obtain above 5,000 cubic feet in a minute, through the long narrow single air passages which conduct to the banks in thin beds; but it is frequently easy to employ two channels for a great length of the intake, and to double the return-course. This would immediately increase the quantity of air, which might be commanded for the workings, and if found too much for the supply of them, some doors and sheets might perhaps be dispensed with, and a more diffused ventilation be allowed. It is hardly practicable to carry above 10,000 cubic feet of air in a minute by a working face, except in very thick beds; far less than this is the usual quantity —it is more common to find 1,000 or 1,500.

The following are a few measures of the total quantities of air which are made to circulate through Yorkshire collieries in consequence of the full or intentionally restricted action of the furnace:—

Ardsley Main	30,957	(1850)
Darley Main	30,780	(1850)
Elsecar	10,708	(1849)
Emroyd	10,408	(1850)
Middleton	4,445	(1850)
Rothwell Haigh	23,000	(1850)
Silkstone	18,931	(1850)
Stubbings	10,927	(1849)
Thorpe Hall	5,442	(1850)
Tordoff (Low Moor)	5,925	(1850)

The state of discipline in the collieries which I visited in Yorkshire, appears to me very similar to that in the Derbyshire pits, and not to require special additional remarks. Lamps were used in Ardsley Main and Emroyd Collieries; but until the employment of them is extended through many collieries, it would be unreasonable to expect the same rigorous discipline as to their employment and condition as in the Newcastle district. The lamps on the Tyne have (always, I believe) 784 meshes to the inch (that is, 28 in the length of one inch); and this is esteemed a matter on which experience has decided. Some of these in Yorkshire have fewer meshes and stouter wire.

ACCIDENTS.

Serious accidents by explosion had been, for a long time, rare in the Yorkshire coal district, when, in 1847, Ardsley Main exploded with a loss of 73 persons, and, in 1849, Darley Main followed the ominous example, destroying 75 lives. Since the last date no explosion causing death has come to my knowledge, except one case which happened in Thorpe Hall Colliery, July 23, 1849, where two men died, the inquest on whom (July 24) was ended before the occurrence became known to me. In the course of my survey I have heard of partial burnings and occasional foulings of drifts to a dangerous degree, enough to show that further provision is required against the recurrence of fearful calamities in unsuspected situations.

I have inspected Ardsley Main, Darley Main, and Thorpe Hall, and I think that in neither of these collieries is any amount of danger to be apprehended, beyond the control of good management and strong ventilation. The accidents in Ardsley Main and Darley Main have been already subjects of Reports to the Home Office; and it is encouraging to believe, that the present highly improved condition of these important collieries can be traced to the operation of these Reports, and the friendly spirit of the investigation. Ardsley Main has now, under the advice of Mr. John Woodhouse, and the superintendence of Mr. Wilson, enlarged its air channels, increased the flow of air, and amended the arrangement of the works. A new and powerful furnace is in process of construction; lamps are extensively used in the works; exploring drifts are kept well ahead, and improved discipline reigns in the mine. Darley Main, by a new and effectual upcast shaft, and an improved arrangement of works, is aspiring to a high place among the creditable collieries of Yorkshire, and certainly ought to attain it. As already stated, the accident at Thorpe Hall Colliery arose from the blocking up of the air course, by coal left in the straight work; a circumstance especially to be guarded against in the narrow single air channels common in Yorkshire. It is too likely to happen again in other collieries, not to require both a closer attention of underground officers to the state of the pit when the men leave their work, and some modification of air channels so small and easily impeded by falls, waste coal, and even the trams employed in transporting coal.

The Yorkshire collieries, upon the whole, cannot be said to be so favorably circumstanced as those in Derbyshire, in reference to the extrication or accumulation of gas. Fire damp is found in considerable abundance in many of the seams,—as the Silkstone Bed; the coal of Emroyd Colliery (Flockton); the Deep Bed at Middleton; the Rothwell Haigh Coal; and the Barnsley, or thick bed. In this bed at Ardsley Main I found the gas issuing

in the angle, at the extremity of the south exploring drifts (rise end of the coal), so as to fill the Davy lamp almost continuously with flame. Yet along the drifts no less than 12,000 feet of air were passing in a minute, nor was this at all too much. The coal, in fact, abounds in gas, and the freshly-cut ends and small fissures everywhere give out gas in the most advanced cutting, whether that be a working bank or an exploring drift. The flow of gas is easy and free, so as to drain the coal for many yards, and there is rarely any blower. Under these circumstances strong ventilation and the lamp make the mine quite safe, as far as fresh cutting and the extrication of gas is concerned.

But there is still the gob to think of. The roof in many collieries of Yorkshire does not fall so freely as in Derbyshire, and the Yorkshire system rather prevents its fall by the comparative shortness of the banks (20 or 30 yards is a common length). They might often be lengthened without otherwise changing the system. When a fall does take place it is sometimes extensive and injurious, and makes a puff of gas dangerous to the men working at the bank.

Longwork in all its varieties is comparable in important points to the pillar-work (or working in the broken) of the Tyne; it is very generally performed by naked lights; the more reason, therefore, for a strong, steady, current of air, to sweep with a perpetual pressure between the bank and the gob; between the unexhausted source of fresh gas and the irregular receptacle, which may be filled at one time with pure air, at another time with carbonic acid; or carburetted hydrogen. I am confident that, by easy means, the quantity of air circulating through Yorkshire collieries may be much and generally augmented, as in fact has been done at Ardsley Main and Darley Main, with signal benefit to those establishments.

GENERAL CONCLUSIONS FOR ALL THE DISTRICTS.

1. Explosions in collieries are only possible when certain physical conditions are allowed to concur, in time and place, with certain artificial circumstances; and this concurrence may, in a majority of cases, be prevented.

2. The physical conditions are only in a limited degree subject to human control, but they are not entirely beyond regulation.

3. The artificial conditions are very much under the control of the managers and workmen.

4. It is not so much by other modes of working, new systems of ventilation, or more ingenious safety-lamps, that danger is to be warded from a mine, as by superior skill and unsleeping vigilance in administering the best methods already known, so as to

prevent the concurrence of the physical and artificial elements of danger.

5. Two classes of fatal agencies are developed by an explosion; one kills by mechanical violence, the concomitant of enormous expansion and contraction of air, the other by the poisonous gases which replace what was respirable air.

6. Neither of these agencies is entirely beyond human control; the mechanical force can scarcely be resisted, but it may be in some degree directed; the narcotic may be weakened in power and abridged in time, so that restorative aid may be quicker and more effective, by skilful arrangement of air channels.

7. To provide easy and sure means of imparting the due amount of practical and scientific acquirements to the managers of mines, well-appointed provincial mining schools, suited to all the grades and duties of mining officers, are essential.

8. For securing the right use of that knowledge in the actual management of mines, a systematic inspection, under the authority of Government, appears desirable.

9. For the due and useful performance of this duty, so as to do and advise what is right and avoid doing or advising what is wrong, technical knowledge is indispensable.

10. The mining schools should be inspected with no less care and attention than the mines.

SUGGESTIONS REGARDING MEASURES OF A PRECAUTIONARY NATURE WHICH CAN BE PROPOSED FOR DIMINISHING THE CASUALTIES OF WORKING COAL.

The object of such measures must be:—

1. To lessen the danger of accident.

2. To lessen the injurious effect of any accident which may occur.

These desiderata cannot be supplied without an ample and constant flow of pure air; a good plan for the distribution of this air through the works; and a steady and vigilant discipline. Before the men are allowed to commence working, the state of every working place and road and run of air should be completely examined, and the men, in consequence, permitted to work with candles, or required to use safety lamps, or forbidden to enter the mine at all: a report of each day's examination being duly entered in the office books.

The primary duty of a public commission will, therefore, be to take measures for ascertaining, in respect of every colliery, the natural sources of danger to which it is liable, and the degree in which, by carrying out the above principles, the danger is prevented, or the men are guarded against it.

The Commissioners must ascertain, in respect of every colliery,

by personal examination, or by reports of authorized agents, what dangerous or injurious gases are produced, what means are adopted for ventilation, what is the efficiency of these means, what are the rules for conducting the mining operations, and how these rules are enforced.

They will be called upon to form a judgment whether a colliery may be worked entirely with naked lights; whether lamps ought to be substituted in certain parts, or used everywhere; and, in extreme cases of dangerous physical conditions or bad arrangements, whether the working of the mine ought to be contracted or suspended.

For the due performance of these duties the Commissioners must have power to enter and examine the mines, or to appoint persons to enter and examine them; to call for plans and sections of the works, returns of the measured quantities of air circulating through the mine, and such descriptions of the natural condition, artificial arrangements and discipline under which the mine is conducted, as may clearly and fully make known its actual working state. Where these data do not exist, or may not be supplied, the Commissioners should, probably, have power to direct special surveys to be made at the cost of the colliery establishment.

If to each member of the Commission a definite district were appointed, he might, with the help of sufficient assistants, exercise in it all the functions of his office, including the giving advice, and offering remonstrance in cases which require it; but the higher function of intervention (which it is presumed would seldom be called into action), to whatever extent it should reach, and whatever form it should take—whether by an official Report to the Home Office, by public notice, or by direct control of any part of the working system,—might be reserved for the concurrent opinion and authority of the whole Commission assembled formally for the purpose.

By this process three evils will be avoided:—1. The mining interest will be guarded against the undue exercise of power by a single agent. 2. The Home Office will be spared many difficult technical discussions, from which it could not escape were the Commissioners deprived of all collective function and responsibility. 3. There will be no necessity for attempting to regulate by Act of Parliament processes which must vary with circumstances that cannot be foreseen.

JOURNAL OF MINING LAWS AND REGULATIONS.

AN ACT TO INCORPORATE "THE M'CULLOCK COPPER AND GOLD MINING COMPANY."

Sec. 1. Be it enacted by the General Assembly of the State of North Carolina, and it is hereby enacted by the authority of the same, that Nathaniel H. Wolfe, Thomas C. T. Buckley, Franklin Osgood, Thomas C. Durant, and their associates, successors and assigns, are hereby *created, constituted and continued* under the laws of this State a body politic and corporate, by the name, style, and title of "*The McCulloch Copper and Gold Mining Company*," for the purpose of exploring for gold, copper, and other metals or minerals, and for mining, vending, smelting, and working the same, and by that name shall have perpetual succession, and be capable of suing, and being sued in any court of law or equity; may have a common seal, and may make and alter the same at pleasure.

Sec. 2. That the corporation above named, and hereby created, shall, by its corporate name, be capable in law of holding and conveying the real and personal estate in the county of Guilford, in this State, now held, owned, or occupied by the persons named in the first section of this act, their associates or assigns, or which is or may be held, occupied or possessed by any person or persons in trust for them, and shall also be capable in law of purchasing, holding, and conveying any other real and personal estate whatsoever, which may be necessary to enable the said corporation efficiently to carry on the operations named in the first section of this act; and shall have power, the property real and personal of said corporation to pledge or mortgage to secure the payment of debts, or advances of money to its use.

Sec. 3. That the capital stock of the said corporation hereby created shall consist of shares, par value of the whole not to exceed one million of dollars, the number and value of said shares to be fixed and regulated by the directory, to be chosen as hereinafter provided; all persons interested in the present Company to have shares in this corporation in the same proportion to be evidenced as said directory may prescribe.

Sec. 4. That the stock, property, and concerns of the corporation hereby created, shall be managed by a Board of Directors, consisting of nine persons, one of whom shall continually reside in this State, who shall be, in the first instance, chosen and elected for one year, at a meeting of the stockholders of said corporation, to be called at such time and place as the persons named in the first section of this act, or a majority of them, may designate; and thereafter they shall be annually elected by the stockholders at such time and place as the by-laws of the Company may provide. The stock of the Company shall be deemed and considered personal estate, and be transferable as the by-laws may direct.

Sec. 5. Be it further enacted, That the Directory of said corporation shall have power to make such prudential by-laws not inconsistent with the laws and constitution of this State, or the United States, as they shall deem proper; regulating the time, place, and manner of holding elections; the filling of vacancies in their own Board or otherwise; the payment of dividends; the transfer of stock; the management and disposition of its property and affairs; the regulation and appointment of all officers, artificers and servants; the conduct of its business; and for all other matters within the objects and purposes of the corporation. It shall also be the duty of the Directors, twice in each year, to make to the stockholders a full and accurate report of the operations of the corporation at a meeting to be called for that purpose, which report shall be verified by the oath of the presiding officer for the time being of said Board, and the superintendent of the operations of said corporation.

Sec. 6. Be it further enacted, That in case it shall appear at any time that an election of Directory shall not be made on the day regularly appointed

therefor by the by-laws of the corporation, the same shall not for that reason be dissolved, but shall be lawful on any other day to hold an election in such manner as shall be provided for in said by-laws; that said Directory shall continue in office, and all their acts shall be valid until their successors shall be elected.

Sec. 7. Be it further enacted, That this corporation, and the rights and powers created thereby, shall continue and endure for fifty years, and that this act shall take effect from its passage.

Read three times, and ratified in the General Assembly, 12th day of February, 1855.

SEWANEE MINING COMPANY.

Directors, Samuel F. Tracy, Henry L. Pierson, Henry W. Peck, Benjamin W. Hart, Benjamin Tomes, George H. Dunscomb, Thomas C. Mosquera, Walter C. Green, D. Colden Murray, Jeremiah Leaycraft, A. Wellington Hart, of New York; Return J. Meigs, William Warne, Samuel D. Morgan, O. B. Hayes, and V. K. Stevenson, of Nashville, Tenn. President, Samuel F. Tracy. Vice President, George H. Dunscomb. Secretary, Henry Ward Barnes. General Agent at the Mines, Andrew Tod. Superintending Engineer of R. R., Gerrit S. Backus. Mining Captain, Leslie Kennedy.

ORGANIZATION OF M'CULLOCK GOLD COMPANY.

Directors, Nathaniel H. Wolfe, Alexander Hamilton, William G. Lord, John L. Buckley, Thomas C. Durant, Gurdon J. Leeds, of New York; W. W. Palmer, J. A. Gilmer, of North Carolina; C. W. Newton, of Norfolk, Va.

COMMERCIAL ASPECT OF THE MINING INTEREST.

NEW YORK, *April* 2, 1854.

The state of the money market has become one of settled ease at low rates, so that no impediment exists from want of moneyed means to a more rigorous application of capital and labor to the development of mines and to a great activity of transactions in mining stocks. But monetary ease is not the sole, though the most essential condition of activity. The sense of profitableness in working mines which have been stopped is not great enough. Want of confidence, if not in the mines, yet in the parties who manage them, prevails to an extent which prevents any immediate renewal of activity.

However, the ease of the money market is assured for the spring and summer if not the autumn, and as the cost of labor has been greatly reduced, there is a prospect of more activity in the working of the mines this season than prevailed last year.

The Lake Superior copper mines seem to take the lead, except over coal mines. The Cliff mine has just declared a half year dividend of five dollars per share, following close upon the declaration of one by the Minnesota Company which we recorded last month. The last named company has increased its number of shares from 3,000 to 20,000, and increased the par value to $50. The holder of these shares of old stock receives in exchange a new certificate of 20 shares. The stock is now selling at $180 to $200 per share, which is a

rise of $35 to $50 since the declaration of the last dividend of $30 per share. It is now paying ten per cent upon $50, though the company is still comparatively young in existence. Its product increases every year, and with the increased European demand for our native copper, will be further highly stimulated.

The Copper Falls Company has made a call of four dollars per share.

Respecting the Tennessee mines we have little beyond the facts that Mr. Lyman Gilbert, the highly active and useful secretary of so many of the Tennessee Companies, is still in London, conducting negotiations for the sale of some of them, as to the progress of which he writes very favorably. The Isabella mine is the most productive. Mr. John Stanton has also gone to London to try to sell the newly formed company called the Eureka.

The Fulton Mining Compang extended the time to 14th April for the old stockholders to exchange their old stock for new according to the terms proposed: namely, receiving one new share for five old ones, and paying one dollar per new share assessment. Unless this is complied with, the old stockholders will be excluded and their stock declared forfeited.

The Gardiner Gold Company is in vigorous life, never having faltered in pursuing the development of its works; and never being in want of money. It is a productive company and will reward its enterprising stockholders.

The sales of copper and gold mining stocks are not large, and are made privately. The McCullock Gold and Copper Mining Company has borrowed $40,000 to pay off its floating debt, and continue the works. This company seems to inspire more confidence. The lead and zinc companies are out of date. The New Jersey Zinc Company, the best of the zincs, still exhibits bad management, and its stock sells at only four dollars per share. It is said to be doing a large business, but where and how the money goes, there is no one to tell. The Pennsylvania Zinc Company is wholly out of sight and seems to be beyond the power of revival on this market.

The Coal Companies continue the most active as regards their stock transactions. Reading takes ever the precedence. There has been a very active speculation in this stock during the month, and it has risen to 85. The new American Coal Company, of Alleghany County, Md., have called for the payment of another instalment of 2,10 per share, now payable.

The Cumberland Coal Company is an active stock, and made the subject of constant speculation, which invests it with much interest, but gives origin to constant fluctuations. The long talked of dividend is postponed, until after some arrangement can be made with the debt of $587,000, for which the coupons fall due on the 1st January next, and towards which they have about $300,000, if not got rid of by a dividend.

The Delaware and Hudson Canal Company have made a statement, showing a profit of 15½ per cent in their capital during the last year, yet their stock sells at 124; the premium is out of proportion to the profits of the year.

The Delaware and Lackawanna Railroad and Coal Company is progressing towards completion. It is delivering coal on a portion of its line in connection with Canada, to which market there is an increasing export of our anthracite coal.

The great pressure in money matters which prevailed all last year has had serious effect on the mining interest; and has weeded the market of all ill-supported enterprises. It has been estimated that $100,000 worth of protected paper has been returned to Wall street from Lake Superior region since last fall. This with a scarcity of powder is represented to have retarded operations very much. Very few of the mines had a full supply for winter work. The *Toltec* discharged 120 men in February, leaving only 100 for working the mine. Parties of miners and workmen were wandering over the country in search of employment. The *Algomah* has suspended operations from a want of funds; the stockholders not paying assessments which have been made. It is hoped that on the opening of navigation, a better state of things will obtain, as money has become so easy in New York.

Mr. Stevens, the well known mining agent, has gone to London, to negotiate for the sale of copper, a market for our product having sprung up there as well as in France.

The prestige of mining stocks has at present been lost from the false principle on which mining operations have been pursued. The main thing has been to do only enough to make the stock active in Wall street, and realize a profit, by the creation of companies with a large nominal capital, of which the great proportion is given for the real estate, which has been valued at an enormous multiple of its actual cost. This was the principle on which the now defunct Parker Vein Coal Company and many others were organized; the original parties selling out at a profit, and leaving others to work the mine as well as they could. Instead of this those who engage in mining speculations should proceed, as in all real estate operations, to invest with a view to actual cultivation and development of the property. Much time and capital are wanted to work mines so as to bring them to a remunerating condition, and it is not good to start the stock in the market until they have reached that point where their value would be of a fixed character, because intrinsic, and only liable to such changes as arise from the rise and fall in the value of money. It is not many years, we believe only eight, since it was known that copper mines existed in Lake Superior, and much has been done in that time; but the next eight years will multiply the products a hundred fold. A mine, even if good, if worked with insufficient means, cannot be made remunerative. Assessments are seldom met with promptness; and unless a working capital paid up in cash be provided, the mine had better be left untouched. To raise money by mortgage of the mine will lead only to eventual ruin of the stock, for a more fortunate speculator to come in and buy at a low price. The North Carolina Company are suffering from this mode of proceeding at the present time. If the brains are out, the man will die; so will a mine, without a cash capital.

The great bulk of the production of coal for the season, we are informed, has been sold at fair and remunerating prices. What little remains in the market is now held at advanced rates. The retailers at Philadelphia have generally secured their supply for the season, but they have not yet published their prices. Prices by the cargo on board vessels at Bristol, we understand, are for lump, egg and stove, $4,97½ per ton; for broken, $4,75 per ton of 2,240 lbs. Of the first-named sizes, little can be had at any price, and not much of the latter.

JOURNAL OF GOLD MINING OPERATIONS.

CALIFORNIA GOLD FIELDS.

The late dates from California bring very favorable accounts of rainy weather, and the prospect of an ample supply of water in the mining region.

New Mining Region—The last steamer from the Southern Coast brings us intelligence of the discovery of rich deposits of gold, which deserve more than the mere passing notice that they receive from the press generally. The demonstration of the fact that mining will pay well throughout the Kern River country is of the utmost importance to the State, as affording another and most startling proof, not only of the richness, but of the extent of our mineral region. From the San Joaquin, which has heretofore been considered the extreme southern boundary of the mining country, an immense district stretches on before Kern River is reached. It has certainly been known heretofore that this section of the State was auriferous, but the gold was considered so fine as to be difficult to save, and as was generally supposed, existed only in very small quantities. The recent discoveries prove that this hypothesis is altogether erroneous. Even with the common and old-fashioned appliances in use among the miners there, and with the want of water retarding operations, it is pretty well established that good workers can make from $7 to $10 per day in this newly opened region, which is equivalent to from $20 to $40 per diem with such mining as is done around Nevada, and in most sections of the North. In other words we have to chronicle the opening of a country as extensive as that from the San Joaquin to the Middle Fork of the American, or as large as the mining region of the counties of El Dorado, Calaveras, Tuolumne and Mariposa. A country well supplied with water in most sections, well timbered, and containing, as will be acknowledged by all who have ever traversed it, some of the very finest agricultural lands in the State. We look upon these recent discoveries of gold as of the very utmost importance to the State. The mines after all are the great inducement to immigration to California, and we can send forward no better news to the East than such as we record with regard to Kern River and Four Creeks. Such statements, apparently well authenticated, will bring more people to this country than all the records of "big strikes" and "huge lumps" found by occasional lucky prospectors. The laboring men in the East want the assurance of a proper field for labor and the certainty of regular returns for regular work. The old dreams of finding a fortune in a day have very properly been dispelled. All that is required for California is to have the truth about her known to the struggling millions on the other side of the land—with her resources she wants no puffing.

Our advices from the Northern sections of the State are still more encouraging. The popular impression was for a long time that gold was only found in the Sierra Nevada; but it is now demonstrated beyond the possibility of a doubt that the coast range is auriferous to fully as great an extent. Klamath, Trinity, Humboldt and Siskiyou counties are a mass of mountains all richly impregnated with gold, and in them the precious metal is found not only on the hills and gulches, but even in the sand on the sea beach. A district of country nearly as large as the great State of Indiana is as yet, it might be said, nearly untouched by the miner, at the same time that it is known to be one of the richest in the whole State. With such facts before us, we may well laugh at the idea of the mines giving out. Our firmest conviction is—and we have had the fullest experience in mining and the best opportunity of examining the country—that *the mineral wealth of California has not yet been touched.*

WATER COMPANIES.

The scarcity of water for the last two months in the diggings, has aroused attention in California to the importance of the Water Companies. From the many articles in the press on the subject, we select the following:

The great complaint from the mines is want of water. Only give us water, say the miners, and we will make business good all over the State. But if the rains won't come, what are they to do? If the mountain won't go to Mahomet, Mahomet must go the mountain. If the water won't come to the miners, the miners must go to the water. It is now evident that the only way for the miners, and, indeed, for the whole State, to be saved from the effects of long-continued drouths, is to take the water from the beds of the rivers and carry it in canals over the gold-bearing country. Such canals have been constructed in many parts of the country, and those canals have saved the country from absolute ruin. By the aid of them, many men are kept at work who would otherwise be idle a large part of the year; and it would be possible to keep every miner in the State actively and profitably employed all the year round, if the water that now runs to waste through the heart of the mining region could be made to leave its natural channels and course its way over the auriferous flats, and along the ridges of the gold-bearing hills. If this were already done, we should then know nothing of hard times. There would be always and constantly a stream of gold tending towards this city, and business would be always good. But to get the water to those points where it is needed requires a large outlay of capital, and in many instances more than it is possible for the miners in the vicinity to command. Now, there are regions of country over which, if water could be brought from the adjoining rivers, at least 8000 men could be supplied with abundance of water, where now there is hardly a man employed. The expense of the ditch might be a quarter, might be half a million. Now it would be a moderate estimate to say that 8,000 men would take a quarter of a million of dollars every month. This amount would materially affect business, and it would not only benefit the miners who took it out, but in like manner the whole people of the State.

It has been remarked frequently that stock in mining water companies did not pay. We suppose such to be the fact, in most cases. But, we ask, what would have been the condition of the country, if the water companies had never existed? What amount of business would have been done for the past six months, had the mining been confined to the banks of rivers, and the creeks and gulches? Very little indeed. And now we put the question, and ask is it not well worth the attention of capitalists to consider whether it is not well for them, and for all men doing a large amount of business, to invest in ditching and canal operations, even though the investment, *per se*, might be a bad one?

We have been led into these remarks, by having our attention called to various ditching operations that have been recently undertaken in various parts of the mines. We alluded last week to an operation of the kind that had been started in Tuolumne County. Our attention has since been directed to another similar undertaking in the northern mines, commencing at a point well up on the Feather River, and running southwesterly and terminating at Owsley's Bar on the Yuba, and Ophir on the Feather. We are assured that a ditch could be built for a small expense, taking a large quantity of water from the bed of the river, sufficient to supply several thousand people with water throughout the year.

QUARTZ MINING.

Extract of a letter dated Grass Valley, Dec. 14, 1854.

The Croakers at home will think the mines are exhausted. Let them think so. We do not care. Even the threshold of the gold regions is barely

crossed, and the great field still lies before the mines. Rich discoveries have been made here since you left, and more gold than ever will be taken out at this place when rain comes. With new discoveries new towns are springing up, and settlements are creeping up towards the summits.

Quartz mining is prosperous. Nobody now cares whether capitalists invest in it or not. Every mill that is in operation here (and there are eight,) is making money. The Empire Company takes out every week from six to ten thousand dollars. I sent down for them this morning $9,600, the result of crushing from Tuesday to Friday. The Helvetia Company are moving their mill down to their lead; there they will have plenty of water, which is scarce at their own mill, and they will save $800 per week in team, work and hauling ore and wood. A new mill is just ready to start, built on the site of the Richardson mill, and owned by Mr. Wood. You recollect Walsh, Raymond & Co. have bought the property and are building the mill. The lead is a good one. Nobody now cares whether New Yorkers or Englishmen have any faith in quartz mining or not. Those engaged here have worked through their difficulties, have learned their business, are already making money, and are investing their surplus funds in other leads.

ROCKY BAR COMPANY.

The following particulars respecting one of the New York Companies are furnished to us by the Grass Valley *Telegraph*, published in the neighborhood of the mine.

The Rocky Bar Mining Co.'s new works, on Massachusetts Hill are nearly completed. One of their principal objects is to effect the drainage of Massachusetts Hill, where they hold extensive claims. The quartz veins in Massachusetts Hill, have been proved to be among the richest yet discovered, and the principal ones have been worked down to the water level. The yield from these veins has never fallen below $35 per ton, and has been often as high as $100 and upwards. A fair average of the rock hitherto extracted, would be from $50 to $60 per ton. Mr. Seyton, the director of the R. B. M. Co., proposes to strike the vein, from his engine shaft at a depth of 140 feet, more than double the depth of the deepest shaft, yet sunk on Massachusetts Hill, as by so doing, he not only will command a larger "face" of rock, but he will also, (if we may judge from the rule in all our quartz mines hitherto wrought,) at that depth, have a vein of increased richness and thickness, besides securing the effectual drainage of the hill. The pump and engine connections were made at the Benecia Iron Works from the designs of Mr. Seyton, and are fine specimens of California manufacture, besides being unique in this country. The pump is a lifting one, 6½ inches in diameter, with a six feet stroke, capable of raising over 200 gallons of water per minute, from a depth of 150 feet. The engine and pump gearing are completed and in their places, and, as far as we can judge, form one of the best constructed pieces of machinery in the Valley. The boiler is solidly set in brick, the first that has been done so, in this neighborhood. The engine house and mill buildings, cover an area of more than four thousand square feet, forming, perhaps, the finest and strongest framed building yet erected in the township. The shaft has been sunk to water level, and is timbered in a most workmanlike manner, while the shears and framing at the "pit mouth"—including a tremendous looking stage for carrying the bell-crank that works the pump, and a capstan that would raise all the best bower anchors of the allied fleet at once, seem models of strength and efficiency. The sheer poles, towering 50 feet high, form quite a feature in the landscape. We learn that "the steam will be up," and the sinking of the shaft below the water level, will be commenced this week. The R. B. M. Co. have one of the best leads in this vicinity, are among our oldest *locataires*, and we wish them every possible success.

The most beautiful specimen of placer gold which we have seen for many a

day, was presented us last week, by Messrs. Johnson & Co. The specimen was taken from the Wisconsin Tunnel, at Iowa Hill, and is about half the size of a hen's egg; it is composed of gravel, or a kind of cement, and is supposed to contain nearly twelve dollars of coarse gold. The Wisconsin Tunnel may, from this, be inferred to be very rich.

The Jackson Tunnel, of Grass Valley, still continues to prospect well. We saw a pan of the dirt yield, on Friday last, nearly a dollar of clean scaly gold.

Mining Correspondence.

Iowa Hill, Feb. 11th, 1855.

Dear Sir—The lack of rain so sadly experienced all over California, causes business at this locality to continue dull. Most of our people are, however, still at their work, and encouraging prospects are daily obtained. The Wisconsin Tunnel have as yet done very little more than prospect their claims, and get them in good order for working. Last month, with two men drifting part of the time, they took out $3,000, and the month previous $5,000. They have now nearly completed their arrangements to keep 8 drifts at work, and expect a proportionate increase.

The next claim, the Hazel Green, washed last week from gravel taken out during the summer, 235½ oz. The Jamison claim, from want of water, has not been wrought this season. Their arrangements are, I suppose, the most complete in California. They have got 160 feet pressure on their hydraulic, and the leather hose alone cost them on the ground $1,400. They have also four stampers to crush their tailings. The Sailor Union Co., Rich & Co., The North Star Union Co., and Huff & Co., all on this Hill, are getting most encouraging prospects, and all we want is water to make the place as lively as it was last spring.

On Roach's Hill, six or seven companies have got in with prospects as high as $43 to a pan. Bird's Flat is yielding very well, those who have claims opened, and can get water, making from 1 to 5 oz. per day to the hand. On Wisconsin Hill water is now abundant, and the claims are yielding as well as last season.

The road to Illinoistown is in excellent condition, and by the way, an effort is being made for a division of the county, as the eastern portion is situated from Auburn, at a most inconvenient distance. "Tunnel."

RESEARCHES ON THE PACIFIC COAST.*

Much speculation has existed among miners and others relative to the source of this gold, and the manner of its deposit; some have supposed it to have been carried out of the adjacent rivers in fine scales, with the sand, and thrown on the shore by the upheaving of the waves; others, that it is thrown up in like manner from the bed of the ocean, where they suppose there exists an inexhaustible supply; others still, suppose it to be deposited in some way by the washing of the bluff, for these deposits are in nearly all cases found opposite such bluffs, which are the termini of disintegrating table-land; but they have not been able to show why it should exist in such quantity in deposit, when it is known that although gold is found to be extensively dispersed through the different strata of the bluff, yet the deposit in any given area, is many times greater than all which exists in an equal area through all the different strata of the bluff, from the surface downward.

The explanation I offered, and theory I advanced is substantially as follows:

It being admitted, as observation shows, that fine gold, though sparsely scattered, exists in most or all the strata composing the bluffs, which in nearly all cases exists opposite the deposits; I imagine that by the action of the waves at the foot of the bluff, at extreme high tides, the bank is undermined, and

* [Continued from page 182.]

the crumbling portions deposit the heavier particles of gold at the base; and by the agitation caused by the rolling surf, the sand and gravel become disturbed, and the heavier particles of gold and black sand settle to the lowest accessible points among the lighter sand and gravel of the beach thus disturbed, which is usually in contact, or nearly so, with some stratum too unyielding or too low to be thus disturbed by the waves; and as this process proceeds continually, that deposited at one period near the base of the bluff, will after a lapse of ages, by the recession of the bluff, be found at considerable distance therefrom; when, on account of the slope of the beach, although at first deposited at some depth, is now become exposed to the direct action of the surf, which action forces it up again to extreme high water line, where the agitation again causes it to become embedded as before, and hence as this action continues through a long succession of ages, or during the destruction of a large extent of land, we have deposited the gathered wealth of all the disintegrated land for unknown ages, laved and accumulated by the rolling action of the waves; and that which was once scattered as the winds, is in this manner collected by Nature's mechanical laboratory for the use of man. How grateful ought the successful miner to be, to the power which has thus so diligently collected and kept in store for him this deposit.

These deposits do in all cases, and, I imagine, can only exist consequent on the disintegration of a stratified formation; secondary, as compared to the primal range. For, although it should be shown, that gold exists among all the materials composing the hills and mountains; yet the accumulation could only be effected on a stratified bed of sufficient consistence and uniformity, and at a suitable depression below the flow of the tide to receive and hold the current deposit and accumulations. These qualities cannot exist in an unstratified formation; for in such case, no uniform bed would be formed to receive and retain it, but the gold first deposited would become in a manner indefinitely commingled with the accompanying gravel; and if by continual agitation it should not at first be caused to descend too far, it would by the subsequent action—as it should be nearly exposed by the slope of the bank—become again so disturbed as to seek and acquire a lower station, and would so continue. Hence no accumulation could exist; and no more would exist in any given area on the beach than formerly existed in an equal area in the superior strata of the bluff. . The stratum containing the gold deposit is usually found underlaid by a bed of blue clay, or gravel, or hard sand, which bed is always an original stratum and base of the bluff. The deposit seldom approaches nearer than eight or ten feet to the angle of the bluff; nor does it often continue fully to the line of ebb tide.

The deposits in the vicinity of Gold River extend about two miles south and nearly eight miles north, with occasional interruptions by rocky bluffs intervening. The table bluff, on the south side, is low, not exceeding ten or fifteen feet—the land being sandy for a mile or so back, and nearly destitute of soil; but that on the north side is from thirty to eighty feet high, and covered with a soil of rich vegetable mould two feet deep, underlaid by a substratum of clay. Below this is gravel and sand alternately, with occasional rocky boulders. On the beach are many large oval shaped pebbles of gneis, measuring from two to five inches across and fron one to two inches thick, being originally deposited from the bluff. Some of the mining claims here yield rich returns. Evidence exists that a large extent of table-land has here yielded to the encroachments of the sea; for extensive reefs of rocks, such as are exposed in the bluff, extend in some places many miles at sea.

The deposits in the vicinity of the Coquille River are, in many respects, similar to those just described, and are of equal or greater richness. They commence about two miles south of the river, where the beach is considerably interrupted by rocks, and extends, with some few interruptions, for about twelve miles north. At a distance of five miles from the Coquille is Randolph City—a mining town of about one hundred houses. Here the bluff is about sixty feet high, and its stratification, observed by me, is as follows, viz:

1st—Soil sandy loans, ...	1 foot deep.
2d—Clay and sand alternating, . .	15 feet "
3d—Sand and fine gravel, reddish and gray, .	15 " "
4th—Sand with some gravel, . .	12 " "
5th—Peat, which could be divided in flakes like bark,	2 " "
6th—Sand, yellowish and bluish clay, .	8 " "
7th—Hard indurated gravel, conglomerate with iron oxide, ...	2 " "

The peat bed or stratum No. 5, extends nearly a mile in the bluff, and in some places is three or four feet thick; and where the peat terminates it is replaced by blue clay, which is from four to eight feet thick.

Here is the peat stratum, and in the blue clay, are the remains of a forest, buried some fifty feet below the surface. These consist of the trunks and limbs of trees lying horizontially, the stumps and roots in their natural positions in the blue clay or peat, which was originally the soil on which they grew; large trees and stumps several feet in diameter, in a tolerable state of preservation, are numerous. On the beach are immense numbers of blocks of petrified wood, partly rounded by attrition. These I found, on examination, are the debris of the fourth and fifth strata in the bluff. A great variety of pebbles, including all the prismatic colors, and many of them translucent, are lying on the beach, also deposited from the bluff. The components of the bluff at Cape Blanco are mostly similar to those at Gold River, except that there is a stratum of sea shells high up in the bluff in some places. Some of the deposits here, though more limited, have yielded extremely well. The washings at Port Orford are of this formation.

It is asked where was this fine gold derived, and how was it originally disposed in the bluff or table-land where it is known to exist? We may ask, at the same time, how and when was this table-land formed; what convulsion or what event caused whole forests, swamps, and hillocks to be buried at a depth of some fifty feet by alternating strata of gravel and sand? Was it at a certain period of the earth's history that these shores, that these mountains and hills were submerged, were lost in the ocean, and then by the hand of Omnipotence taken up and rinsed, as a man would rinse a fleece, suffering the washings from a thousand hills to be gathered in horizontal strata, as plains in the valley? Was it by recurring surges of the great, the mighty deep that these shores, these hills were submerged and reclaimed? Then, indeed, we may suppose the gold, as it may have had an anterior existence among the hills, should accompany the other disrupted integrals, and become a component of the table-lands, and of the deposits thereby imposed.

Our inquiry is now removed but one step further. How was it originally disposed among the hills? Did it originally exist in solution, or in combinations, as with quartz, distributing itself as other gross materials, and afterwards set free from its solvent or matrix? or was it thrown up by internal convulsions from the bowels of the earth, distributing itself in golden flakes, as snow on the hill-tops and in the valleys? Each may answer according to his fancy, or may still remain in doubt.

North of Cape Perpetua is a bluff and beach, similar in many of its features to that at Randolph. A forest is here, in like manner, buried some thirty feet beneath a superincumbent mass of gravel and sand; a stratum of peat, three or four feet thick, is exposed in the bluff; black sand is abundant on the beach. Gold exists here, but it is extremely fine—scarcely more than miscroscopic. The accumulation has not taken place here as in other places referred to, either on account of its extreme fineness or the lack of a proper stratum for a bed. The gold, which was "prospected" by some experienced miners from the gold beach at Randolph, at my suggestion, is found more generally diffused in the sand, but is immensely finer. It was deemed to be impracticable to work the beach profitably at present; but with cheapened labor and improved machinery, it may be done. All the beach gold I have yet seen north of Cape Greg-

ory is extremely fine like this above described. Let it not be supposed that because gold is so generally diffused along this part of the Pacific coast, that profitable washings exist on all places on the beach, or that their occurrence is only accidental. These only occur at such locations where a stratified formation has been disintegrated, and a suitable substratum for a bed exists, and a beach is formed thereon. I would as soon look for gold at the foot of the table bluff at Cape St. George, or that at Point Conception in the south, as at Cape Blanco, if a proper beach and suitable circumstances for its collection existed at those former places.

I have only glanced at subjects of geological and minerological interests of which this portion of the Coast is fruitful. Copious indications of coal exist through all this section; a vein has recently been struck about three miles south of Gold River. Large fields of it exist between the Coquille and Coose Rivers. Indications are abundant on the Umpqua and Sinsclau Rivers. Lead ore is reported to exist at the Alsea River. Having been employed by residents of Empire City and Coose Bay to make a reconnoissance of their coal fields with a view of connecting them with the city and bay by a railway, I found the distance of the out-cropping of one of the principal veins to be about three miles from the city, and at an elevation of about 249 feet above the wharf at that place, and moreover a highly practical route for a railroad with a descending grade to the bay. These coal veins, which vary from two to ten feet in thickness, run horizontally, or occasionally with slight inclination, through the hills, and are miles in extent. Some veins of the coal are immediately on the bay, but those referred to above are considered the most pure and valuable.

STATEMENT OF THE M'CULLOCK COPPER AND GOLD MINING COMPANY.

The stockholders of this Company heretofore organized under a charter granted by the Belmont Mining Company, succeeded in obtaining from the Legislature of the State of North Carolina a charter, and held a meeting on the sixth of March, 1855, at which the charter was accepted, and the Counsel of the Board directed to take the necessary measures to evidence said acceptance in a legal manner.

A Committee, consisting of five stockholders, Messrs. G. J. Leeds, Daniel Low, M. X. Harmony, A. Hamilton, and J. N. Reynolds, were then appointed to examine into and report on the financial condition of the Company, the nature and condition of its resources and property; and also to nominate nin persons, who, on being legally chosen, should serve as Directors for the first year, under the new organization.

The meeting then adjourned until the 13th of March, to receive the report of said Committee; and on that last mentioned day the said Committee, by their Chairman, Mr. Leeds, reported that they had caused to be prepared a statement of the financial condition, receipts and expenditures of the Company, and that they also submitted Mr. Palmer's report on the condition and prospects of the property; and concluded their report by recommending the adoption of the following resolutions:

Resolved, That in the opinion of the Committee, there exists every reason for the belief that the mineral property of the Company is of great value, and they therefore advise and recommend that efficient and prompt steps be taken to collect the necessary funds for the discharge of the present exigencies of the Company, and to secure sufficient means for the future successful development of the mineral wealth of the Company's mines.

Resolved, That in the opinion of the Committee, the Directors hereafter to be elected, be advised and requested to have a proper trust deed prepared, covering the property of the Company, for the sum of forty thousand dollars, and in virtue of which trust deed, bonds for $250 each be issued, bearing interest at the rate of 6 per cent., and payable on or before two years. The Committee further recommend that the surplus stock of the Company be reserved

by the Company, for the purpose of forming a sinking fund in discharge of the loan now advised to be made.

Resolved, That in the opinion of the Committee, there has been a want of proper economy, and an entire absence of mining skill, and that to these errors are to be attributed the difficulties in which the affairs of the Company have become involved; and the Committee consequently recommend an entire reorganization in the management of the Company's affairs, through every branch of its business.

Resolved, That in the opinion of the Committee, the stockholders would be fully justified in placing their confidence in the representations made by the Genl. Superintendent, Mr. Palmer, whose intelligent and energetic measures have already provided a perfect system of mining at the Company's works.

The Committee further stated, that inasmuch as they have found the account books and office arrangements of the Company entirely unsatisfactorily kept, they would therefore recommend to the future Board of Directors to have prepared a new set of books, that all and every operation, transaction, and correspondence may be exhibited with clearness and in detail, subject at all times to the proper and reasonable inspection of the stockholders.

REPORT ON FINANCIAL CONDITION.—BY T. C. BUCKLEY.

SIR:—You will herewith receive a statement of the financial condition and expenditures of the McCullock Company, which I have compiled, at the request of the Committee, from such data as were to me accessible.

From such statement, it appears that the sum of $290,468 55 has been received and expended in the purchase, construction, and expense accounts; and that the present debt of the Company amounts to the sum of $91,908 90.

That of this amount, the sum of $59,921 14 has been funded for three years, and is merged in bonds of the Company, to be issued when its new organization is perfected; which bonds are intended to be secured by a first mortgage on the property.

That of the remainder or floating debt, $17,232 45 is now due, and the balance will mature in the course of the next six months.

To meet such portion of the floating debt as is now due, the Company, as I am informed, have, in the city of New York and on the way, 120 barrels of copper, estimated to be worth the sum of five thousand dollars, and a steam engine, appraised at fifteen hundred dollars.

The remaining property of the Company, paid for, and constituting the basis of their operations, consists of their mining estate in Guilford County, near the North Carolina Central Railroad, containing 204 acres of land, on which are erected the following buildings:

1. A mill and boiler house, containing two steam engines, one of 100 horse power, and one of 15 horse power; 6 Chilian mills, 18 head of stamps, 12 Ball's amalgamators, and 8 shaking tables.
2. Blacksmith's shop, with three forges, two offices, store house, and carpenter's shop.
3. Large warehouse, boarding house, superintendent's house, 15 dwelling houses for miners, 6 whims or gins for working the shafts, in which and in hauling ore, 18 head of horses and mules, the property of the Company, are employed.
4. Another mill house and mills, situated on the Deep River, furnished with two new Chilian mills, in excellent order, with the accompanying necessary apparatus for working them for gold.

There is also on the premises another steam engine.

The property went into the possession of this Company about the first of June, 1853, and active operations were suspended about the first of November, 1854; the main period of active working, however, being between the first of March, 1854, when the machinery was finished, and the first of November.

During the entire period, as near as I can ascertain, the returns from the

mine, from all sources, amounted to $53,064 45, in which I include the estimated value of the copper on hand.

It is to be regretted that no proper distinction has been preserved on the books of the Company between construction and working expenses, so as to show directly what part of the moneys expended was directly applicable to the ordinary cost of working the mine. From an examination of the accounts I have made in connection with a person of some experience in such matters, it appears that the sum of $38,371 11 would be the proportion properly chargeable to the working account. In view of the very heavy rate of expense exhibited by the accounts to have been incurred, it is my opinion that such a yield as is above shown might in the future be attained at a much more moderate expense.

The accounts and books of the Company will, I think, show that of the above total yield of $53,064 45, the sum of $44,126 51 was received, or would be realized from the proceeds of the mine subsequent to the first of March last.

When it is remembered that the mine came into the hands of the present proprietors almost entirely unproved, except at limited depths below the surface, without any of the accessories necessary for the successful prosecution of mining enterprises, and that the Company undertook to work and open the mine, purchase and erect the large amount of machinery and buildings now on the premises, without a dollar of working capital, the actual results, as shown by the accounts, are by no means discouraging, and exhibit, in my judgment, very excellent data from which the stockholders may determine what is the capacity of this property under prudent, skilful, and judicious management.

STATEMENT

Of the Receipts, Expenditures, and Liabilities of the McCulloch Copper and Gold Mining Company, from June, 1853, to March, 1855, excluding, however, all assets or property on hand, of which statement is furnished in annexed report.

RECEIPTS.

The capital stock of the Company is represented by 200,000 shares, of the par value of five dollars each, of which, as appears by the transfer books, 125,000 were issued on account of the purchase of the mine, 55,000 have been sold on account of the Company, and the proceeds used as hereinafter mentioned, and 20,000 are still the property of the Company.

I.—Stock issued, 180,000 shares, 125,000 as above for the mine, and 55,000 sold, yielding in cash to the Company,			$150,500 00
II.—Loan Account, No. 1, being loans and advances from different parties, included in first mortgage,			59,921 14
III.—Temporary loans and advances in the business of the Company, (balance),			7,317 31
IV.—Proceeds of working as far as ascertained. Gold to Nov. 1, 1854,	$34,922 04		
Other property,	2,583 42		
		$37,505 46	
Copper sales,		10,558 99	
		$48,064 45	48,064 45
V.—Bills and debts payable,			24,665 45
			$290,468 35

EXPENDITURES.

Cost of construction, working, salaries, &c.

I.—Payments in cash for the mine assumed to be borne by the McCullock Company, in conveyance to them, and interest, . . .		$144,382 51
II.—Construction account No. 1. Paid for pumps, machinery, amalgamators, steam engine, &c., in New York, ...		43,391 51
III.—Construction and expense account, No. 2, in which all liabilities are included, no distinction is made in the accounts between labor applicable to construction and running.		
Labor, ...	$30,018 98	
Provisions, ...	3,226 97	
Wood, ...	1,680 88	
Hauling of Copper ore, ...	1,664 18	
Machinery, ...	28,136 86	
Salaries paid at mine, ...	7,847 96	
Salaries due,		
Rodman, ...	5,350 92	
Hamilton, ...	1,543 48	
Paid by President's account, since Aug. 1, 1854, . .	9,817 31	
Negro hire, ...	6,380 23	
Suspense account, vouchers unreturned, and expense in New York, ...	7,082 06	102,694 38
		$290,468 35

REPORT ON CONDITION OF THE MINE.

To Gurdon J. Leeds, Esq., Chairman, &c., &c.

In compliance with the request of the Committee appointed to investigate the affairs of the McCullock Copper and Gold Mining Company, of Guilford County, North Carolina, I have the honor to report:

That in December last the affairs of the Company were found to be in a bad state, and the mine not paying its expenses.

I was employed by the Directors to examine the mine for the purpose of ascertaining whether it was worth working or not; and in order more fully to carry out their desire, the Board elected me Vice-President and Director of the Company, that I might have sufficient powers to make such arrangements at the mine as should be deemed proper for putting the concern on a more prosperous footing; and the President supplied me with funds to pay off the most pressing obligations of the Company, as well as for the payment of such miners and other workmen as might be employed to prosecute proper works in case the property should be found worthy of further development—to prevent the loss of time which would otherwise result from the low state of the Company's finances and credit by suspending operations.

The result of my examination may be briefly stated.

With the extent and general description of the property the shareholders must already be familiar; it is sufficient for me to say, that from my own examination I found the vein clearly defined from one extreme limit to the other of the Company's property, in length about three thousand feet.

Having regarded it as my duty to look practically at the present condition of the mine, and to exercise my best judgment with all the lights and sources of information in my power, in shaping the proper action for the future, my first act was to reduce every unnecessary expense, to arrange and get within proper control the various annoying floating obligations against the mine.

My next, a thorough survey of the property in all the workings below as well as above ground. The result of this past labor is shown by the map, which is in the Company's possession.

The evidently unreasonable expectations created by the reports of learned professors, had led to the ruinous policy of exhausting every part and parcel of the ores approachable; and of course the suspension of that regular and

systematic opening of the mine by new and enlarged works, always necessary to successful mining; errors and mistakes of this kind should have no influence with sensible men in forming a just estimate of the mine as a valuable mineral property.

About fifteen hundred feet of the vein has been worked on; eight hundred feet of that to the depth of one hundred and thirty feet, and the remaining seven hundred feet to the depth of sixty feet from surface. Above the lowest gallery there is, therefore, two thousand two hundred feet of ground to be drained and opened by the 130 feet level; fifteen hundred feet of it is entire from surface, and seven hundred feet entire to the sixty feet level, making the proportion of exhausted to yet unexplored ground above this level nearly as 1 to $1\frac{6}{10}$.

One of the shafts has been sunk to the depth of one hundred and eighty feet from the surface, and the vein exposed in copper ore; it is well defined and productive. This experimental work has solved the problem of the existence of this vein in the harder rock below the line of decomposition of the formation through which it runs, which in this property near the vein, is between 130 and 140 feet below the surface.

It can readily be seen that with all the varied workings, extending over a great many years, this should be still regarded as a new mine, and the works as only having demonstrated the extent and strength of the mineral lode both in length and depth. This is the point attained at which speculation should cease, the work be abandoned, or pursued as a legitimate business for the use of capital. And regarding this property as unquestionably of high value, I propose the continuation of the following named works, which are already in progress, and to which a large portion of the advances of the President have been applied, viz:

The driving of the seventy-five foot gallery each way from the Jack Hill shaft, which is situated about eight hundred feet north-east of the old workings, and about seven hundred feet inside the boundary, as an advantageous work for laying open the upper portion of the large section of untried ground, and as a thorough trial for gold.

To drive the 130 feet level from the old workings each way through the whole extent of vein yet to be explored, and drained by that level, making about *two thousand two hundred feet*, which will bring into working order *two large unexplored* sections of the mine.

To continue sinking the deepest shaft on the course of the lode, with a view to laying open the whole mine at increased depths.

As the works progress, the productive laborers can and should be gradually increased.

The value of these works is not to be estimated by the amount of mineral which may be extracted from them during their progress, but from the more important fact of opening the mine in length and depth, and exposing to view all the rich workable portions of the vein, from which time the regular extraction of the ores may be calculated upon without interruption.

As the mine is already abundantly supplied with machinery, pumps, mining implements and material, stock, dwelling houses and other buildings, &c., thi y thousand dollars applied in the direction indicated appears to be the true course for the Company to pursue.

This sum may be much reduced by the intermediate yield during the progress of the works, it is the safer course to provide the money; the appearance of the mine throughout justifies it, and the money, therefore, should be provided; if not needed, it will remain in the treasury. This part of the affair is a simple question for the Company to determine.

The works recommended might heretofore have been carried forward from the legitimate yield of the mine—they are now a necessity to the existence of the Company.

All of which is respectfully submitted.

WALTER WM. PALMER,
Mining Engineer.

NEW YORK, 8th March, 1855.

Pioneer Mills Mine.—At the "Pioneer Mills," the ores are proving very rich; below the water level they are highly charged with copper, but above that point they are taking out the "backs" with profitable returns in gold. At the "Rutherford," operations have been temporarily suspended; but they will be again commenced ere long with renewed energy, aided by adequate machinery.

Rudesill Mine.—At the "Rudesill," the work is progressing with fair prospects, and when this mine shall be fully reopened, there is but little doubt but that it will maintain the rich character it held when worked some years ago. The ores are rich and abundant. At "King's Mountain," the most extensive operations are going forward under the auspices of Commodore Stockton, who has made a conditional purchase of this truly valuable gold tract, and is sparing no expense in the application of mechanical power to the full development of the property.

High Shoals Mine.—At the "High Shoals," the mines are yielding very gratifying results; they are now vigorously driving their lower level at the depth of 137 feet, upon the course of the vein which has gradually increased in size from about two feet at grass to over ten feet at their present lowest level. This company own over 12,000 acres, containing some of the best gold veins in the State; it also embraces a highly valuable iron property.

In McDowall County, on the head waters of the Broad River, Dr. Vandyck is preparing to prosecute a very extensive system of surface washings. He is adopting the "sluice work," so profitably pursued in California, and some idea of the extent of his operations may be gained from the fact that his trenching covers a length of over three miles, and during its course crosses the river several times. Should his attempt prove successful, it will cause an entire revolution in the system of deposit working, in North Carolina. (*Reported for Mining Magazine.*)

GOLD AND SPECIE ARRIVING IN GREAT BRITAIN DURING 1854.

The following are the net arrivals of gold and specie, that is the excesses of the published arrivals over the departures for each of the twelve months of the past year 1854, up to the 30th of December:

January	£2,161,270	July	£1,784,459
February	1,367,540	August	1,726,873
March	748,130	September	2,473,110
April	1,552,041	October	2,710,133
May	2,261,700	November	1,415,747
June	1,621,906	December	1,577,224
Total for the year			£21,400,133

This is exclusive of sums brought and sent away by private individuals, loans, &c.

In the following table, which has cost no little labor, from its size, to compile, the imports of the precious metals are apportioned to the countries from which they were shipped. It should be observed that these are the imports irrespective of exports to them or any other places. Imports are not included which are trifling in amount or from places which send us but little gold.

In the last column, under the head South America, Pacific, &c., is included £253,000 from the East Indies; £388,000 from Mexico, and £40,000 from Russia.

	United States.	Australia.	West Indies.	South America, Pacific, &c.
January,	£453,530	£80,000	£645,710	£265,000
February,	58,900	1,232,240	310,000	......
March,	57,410	444,100	567,000	125,100
April,	339,430	1,430,470	309,370	44,300
May,	735,190	984,000	108,320	10,700
June,	789,360	996,600	560,000	......
July,	1,088,320	865,000	......	466,700
August,	810,140	627,120	404,000	86,480
September,	1,474,990	532,670	428,100	61,350
October,	1,167,760	1,113,890	299,190	36,000
November,	1,138,280	559,290	5,000	508,800
December,	491,290	513,500	714,820	8,690
Totals	£8,604,750	£9,428,880	£4,346,500	£1,573,130

This table shows that we have had nearly as much of the precious metals from the United States as from Australia, and about half as much from our West India colonies as from America. The balance of trade, therefore, has been greatly in our favor from all three places. But it is a remarkable fact that our unbalanced exports from America, if the payments were at all of short date, were much greater during the last than the first six months of 1854, that is during the wilder part of the American mania. In December, however, the returns of gold fell off to less than half the average of the preceding five months, no doubt owing to the rupture of American credit and the fear of our merchants to export.

The Australian trade, measured by a similar rule, showed much more done in the first half of 1854 than in the last, which is easily accounted for by the markets being glutted by our wild exportations to that colony.

It is worthy of remark that according to the gold returns our unbalanced exports—which are usually, though not always truly considered a measure of our advantage by the trade—are only about one sixth to South America, the Pacific, &c., of what they are to our Australian colonies.—*Herapath's Journal.*

JOURNAL OF COPPER MINING OPERATIONS.

LAKE SUPERIOR.

Forest Mine.—One of the reliable supports to the reputation and standing of the Ontonagon Mining District, and proportionately of the entire copper region of Lake Superior, is the Forest Mine. It is one of those earliest commenced, but, owing to mismanagement or some other cause, its development was checked, and it is only until within about two years that it has had the opportunity of exhibiting its wealth under a management at once liberal and economical; and now it is taking its place beside some of the best mines in this country.

It is not, as yet, a dividend paying mine, although it is fast coming to that point, but it has other features that recommend it to the attention and to the careful consideration of all those who care for the mineral development of this country, or who intend to become interested in the products of any mine here; for whatever adds to the value, or more, adds to the certainty of investments in copper stocks and copper mines, adds a material value, and inspires a permanent confidence in the products of our country, at whatever point those products may be sought.

In a visit to that mine we observed some peculiarities that made a serious impression, and became to us texts for some remarks that may find a place in

our columns some future day; the impressions and observations, however, we shall proceed to place before our readers.

Under the guidance of the mining captain, we went underground and thoroughly examined all parts of the mine now operated.

We find here a *lode* differing much from that in mines generally. Throughout the entire ground opened, the vein is very regularly filled with copper in the shape of barrel work. Now and then a mass, with the rock connected, is taken out. We saw several such, and one that would weigh about a ton, and the copper, when disengaged from the rock, will weigh about 1,500 pounds. We saw another mass of copper ready to be taken to the furnace, marked 1,311 pounds. All the ore coming from this mine, with the exception of a few pieces, must pass through the kiln and be burnt, by which process the copper is easily disconnected from the rock, and is then separated into *stamp work* if still minute, and retained in the rock, or *barrel work*, if in lumps, or into *masses* if the copper is too large to be shipped in barrels.

Down in the *fourth level* the same degree of richness seems to continue, although work is not prosecuted at this depth as rapidly as above, because the water retards their progress. Mr. Livingston, the Superintendent, is about putting up an engine at the mouth of one of the shafts, that shall be used as a hoisting engine, and also for keeping the mine clear of water. This engine will probably be in operation by the first of July. It is an addition to the facilities of the mine that is now much needed, for the accumulation of water in the fourth level is so much that it impedes not only the working in that level, but also consumes much expense in hoisting by the means now in use, to admit of keeping the level clear of the material, at the same time: hence it seems a matter of the strictest economy to prosecute the work at that point, and complete the construction of apparatus necessary for that object.

The lode in some portions of this mine is very wide, attaining at some points a width of 24 feet, and very rich.

A very large amount of money has been expended on this mine from the time of its commencement until the present; and within the last two years the management have not been backward in furnishing all the funds required to properly develope the plan and so to prepare the mine for yielding its products, that the greatest advantage could be taken of it.

The policy pursued has been to open this mine as extensively as possible, and by that operation the management can arrive at a certainty, almost, as to the real value of the mine. When five or six shafts have been sunk and three or four levels been driven, it is no very difficult matter for a mining man to come to a pretty certain conclusion as to what will be the value of the ground when stoped out—and here lies one of the great advantages of prosecuting a mine of this kind with vigor, for it is only by this means that a certainty can be arrived at in mining.

Another object of curiosity and interest is the new stamp house, engine and machinery connected therewith, under the care of Mr. Fisher, who is one of the reliable men about this extensive establishment.

Twenty-four head of stamps, a set of tables, and a saw mill is here carried by an eighty horse-power engine. The entire arrangement of all this machinery, like that displayed in all other matters about the mine, is due to Mr. Livingston, the Superintendent of the mine, who is equally intimate with the most minute or important matter that may transpire on the location.

A complete system has been established by Mr. Livingston, by which he knows thoroughly all that transpires. This is one of the most important points to which we would call the attention of Stockholders. All know that we are now suffering under hard times, and what can cause a stockholder to feel confidence, more than to know to the value of a dollar, how his money is expended.

During the past year there has been broken 7,712 feet of ground, in the different points worked as follows:

	No. feet.	Average cost.
Sinking,	273¾	$9.48
Drifting,	1,295	8,26
Cross Cutting,	97½	8,75
Stoping,	5,04??	4,61

Making a total of 7,712 feet, at a cost of $31,412,55. The timbering covers an extent of 1,256 feet running measure, at an average cost of $2,20 per foot, which includes stulls, covering and rearing.

There has been a large amount of work performed in addition to last year, such as erecting houses, stamping mill, washing house, engine and boiler houses, clearing land, &c.

During the past season they have raised and prepared for shipment 73 tons, 1,774 pounds of copper, net weight, as follows:

5 Masses,	10,511 lbs.
180 bbls. of Barrel work,	9,9457 "
46 bbls. of Stamp work,	3,7806 "

There has been likewise raised about 4,000 tons of stamp work, which is all burned and cobbled, ready for stamping, and estimated to contain 3 per cent. of copper. Taking the number of fathoms broke in the mine for the past year, and the total amount of copper raised including the above amount of stamp work, it gives an average of 423¾ pounds, 65 per cent. copper for every fathom nearly.

By the accident to their stamp mill on the 17th of March last, their shipping of copper has been very materially decreased, from the fact that the whole majority of the lode consists of stamp work. By the accident they were prevented from shipping, at the lowest estimate 60 tons of stamp work, while at the same time their expenditures were very largely increased in purchasing and erecting new machinery with all its appurtenances.

The new mill covers an extent of ground 60 by 80 feet, with boiler house attached, and is of a very sup rior character, and constructed with a view to durability and strength, and is every way competent to manufacture the large amount of stamp work yielded from the mine.

The washing or cleansing of the particles of native copper from the impurities in the gangue, after the material is received from the stamps is performed on 8 large percussion tables; these tables are driven by the stamp engine; it works admirably. Copper can be cleansed to 96 per cent. on them with ease, but much difficulty is encountered in separating the ore from the vein-stone, from the fact that a very large proportion of the gangue consists of epidote and chlorite, two minerals of much weight, containing about 25 per cent of iron oxide.

Were a more perfect separation of the pure metal from the gangue attempted than is now practised, that is 65 per cent., it would necessarily entail a loss of a large proportion of the very fine and dust-like particles of copper at present saved.

These fine atoms of copper seem to float in the current of water, while quartz, epidote and chlorite are seen to sink beside them. This fact is incontestable, and we can account for it in no other way than to presume there are infinitesimal globules of gases attached and adhering to the metal through chemical causes tending to float them in the water.

A Tram road, connecting the mine with the stamp works, one and three quarters of a mile long, is finished with the exception of an inclined plain 700 feet long—inclining 22° 37 from the horizon. This road will decrease their expenses materially as soon as it is put in operation, one pair of horses being able to perform as much labor on it as twelve pair on the old road.

This mine has continued steadily to increase in value as the work progressed during the past year; in depth it gains strength, and there are evidences of the lode now worked meeting another from the north in the next lift of shaft No. 3. This north lode is nearly vertical, and is underlaid by the

Forest vein. Some pieces from ½ to 600 pounds have been taken from it, and there is little doubt the yield of the mine will be increased when both lodes come together. A steam engine is very much needed at this mine in order to sink and extend levels below the present depths.

A system of operations, by which every pound of iron or steel, or each ton of hay or pound of oats, and every item of expense in conducting the entire operation, is established and known, so that all interested in the mine may be aware of the manner in which all expenditures have been made.

CENTRAL MINING COMPANY.

A letter from Mr. S. W. Hill states the following particulars relative to the organization and property of this company.

The Central Mining Company's location is situated four and a half miles from Eagle Harbor. It is bounded on the north by the Copper Falls location, on the east and south by the North American Company's lands, and on the west by the Winthrop location: and embraces the half of Section 23, in Township 58 north of Range 31 west, and contains three hundred and twenty acres. Its height above Lake Superior is, in no part, less than five hundred and fifty feet, and nowhere exceeds eight hundred feet. In its southern part is a stream known as the east branch of Eagle River, which will afford a sufficient supply of water for all purposes of dressing copper. In the western part is a small stream which runs to the south into Eagle River. This stream will furnish water for steam boilers, which may be used about the surface of the mine. The location is well timbered with pine and sugar maple, and has an excellent soil suited to the wants of a mine and mine force. There are two good wagon roads traversing it, one running diagonally through the northern part, connecting the Winthrop and Copper Falls mines, and the other through the middle part, connecting the Winthrop and North Western mines. All parts of the surface are easy of access by roads.

The rock formation of the location is the well known varieties of the Trap rock of the country. The Crystalline trap forms a very distinct ridge through the location, a little north of the middle, bearing nearly east and west. This bed is not more than six hundred feet in thickness. To the south of this ridge of crystalline trap rock are the various and alternating beds of granular and amygdaloid traps, extending to the north as far, at least, as to the southern boundary of the location. It is in these beds, to the west, that the Cliff, Winthrop, North American and Eagle River mines, are working. To the east, in the same beds, are the North Western, Summit and North West mines. North of the crystalline beds and resting upon it, are a few alternations of a gray, feldspathic, porphyritic, and dark brown trap.

Those beds are quite soft along the lines of the principal veins traversing them. The crystalline trap is easily mined along the lines of the veins, and is less hard and tough than some of the beds which underlie it. These various beds of rock dip to the north, below the horizon, about twenty-five degrees.

In August last, the controlling interest in the Central lands became the property of Lake Superior men, when an examination for any metalliferous deposits they might contain was instituted. The work of examination was placed in charge of John Robinson, Esq., who after a few days' labor with a small force, opened an ancient excavation—discovered some weeks before by Mr. Slawson, Superintendent of the North Western—in which was found a large mass of pure copper, standing firmly in a vein bearing to the east of south, fifteen to eighteen degrees. This vein was traced to the north into the Copper Falls location. Its existence in that location had been known for more than two years, and not until during the past season has there been any thing done in it in that property. Its mark in the surface is distinctly observable entirely across that location, and nearly through the Central mine lands. Its length, as now known, is over two miles. It underlies to the east, and

has been opened in several places in the lands of the Central Company, and every where found to contain copper in considerable quantities.

In November past, a shaft was commenced to be sunk 70 feet to the north of the mass of copper found in the ancient excavation. When the rock was penetrated to the depth of six feet, water was found too quick to carry forward the work of sinking until an adit gallery should be made to connect with the shaft. In the shaft the vein was found to be of good width and well filled with copper. Some pieces of pure copper were taken from this part of the vein, which will weigh 100 pounds, and there is, notwithstanding, in the vein in the shaft pieces of pure copper.

On the 16th of November, the Central Mining Company was organized, and a small instalment on the stock was called. Messrs. A. A. Bennett, J. Robinson, J. Slawson, and S. W. Hill, of Lake Superior, and W. Palmer, of Pittsburgh, Pa., were elected a Board of Directors. R. W. Bulkeley, of Eagle Harbor, was appointed Secretary. These gentlemen comprised the original shareholders. The annual meetings of the Company are required to be holden on the first Tuesday in June, *on the mine*. The office of the Company must be at the mine. Meetings of the Board of Directors are required to be holden on the mine. It can hardly be expected that a Company organized as this is, will be likely to purchase and erect a worthless and improvident machinery for the use of their mine. They will be able to see at every meeting of the Board just what will be required. The introduction of new shareholders in the mine under these circumstances, might not be required to be coupled, with the purchase of them, some new and untried machinery, which promises much and hails from a distance, its only quality being that of its great cost.

The first meeting of the Board of Directors was held on the day of the organization of the Company. They determined to work but six or eight miners during the winter ensuing. The Company had no supplies at the mine, and but very little preparation made to do *any* work. The Board placed the working of the mine for the winter under the charge of John Slawson, who, residing near the work, could oversee it without any inconvenience in the discharge of his duties at the North Western mine. His first business was to make an adit drain to the shaft. This was done by cutting across the formation along a ravine, in sand and rock, intercepting the vein at the mass of copper above noticed. From this point in the vein, about 70 feet from the shaft, the gallery has been extended along it towards the latter. The gallery was carried alongside of this mass of copper, fourteen feet, when another one was met with on the other side of the level. This one is sixteen feet long, and on an average of five feet in height, and its thickest part twenty inches. It is pretty certain that this mass will be found to produce more than thirty tons of copper. There are not less than fourteen tons of it now in sight. The first mass proved to be over twenty feet long in the gallery, and on an average of four feet in length, and varying in thickness from four inches to one foot. To the north and beyond those two masses, is a third one which seems likely to bear a ton or two of copper in it. Beyond these masses the vein has been found to average four feet in width, well filled with pieces of pure copper as well as stamp work. Some of the pieces of copper will weigh from 70 to 80 pounds, and there is nowhere along the gallery, to this time, over three feet of rock over it. There are now in sight in this work very near, if not quite, twenty tons of copper, and the entire expenses of the Company to the present time will not exceed six hundred dollars.

I have been an observer among the mines of the country since their earliest working; in no one of them have I ever seen one half as much copper, for the same amount of expenditure made, as is to be seen now at the Central. It seems almost certain that a further expenditure of only a few hundred dollars, will bring to light as much more mass copper as can now be shown. It is the most promising mine I have ever seen. I believe it can be made largely profitable with a very moderate outlay.

VISIT TO A COPPER MINE.

For the benefit of your readers who have never seen a Copper Mine, and who at the same time feel interested in them, I send you a description of a tour recently made to a portion of the Range, and of what I saw there.

Our purpose was to go directly from the Ontanagon to the Douglass Houghton Mine, a distance of about twenty-one miles, which is the most easterly in the Ontanagon District, now working. The Shawmut, Erie, and Ontario, not being considered as in this district.

Making a short halt at the Toltec, we go on, and after a walk of about three hours arrive at the Douglass Houghton, having passed on the way the location of the *Piscataqua*, which is now lying idle, the *Indiana*, that is just being opened, and the *Fire Steel*, also a new mine, the two latter being under the superintendence of Col. Joseph Coulter, of the Douglass Houghton.

The equipments for our underground excursion having been put on—the heavy hat, like a helmet, the muddy over-alls and coat, the thick boots—we take a candle in our hand and a box of matches in our pocket, and follow our guides to the mouth of the shaft which we are to descend.

No one, unaccustomed to being under ground, can approach the shaft of a mine, for the purpose of descending it, without an uncomfortable nervous fear. It is so contrary to our established habits, that it requires an effort to conquer it; but it is too late now to hesitate, and we run the certain risk of being laughed at for any symptoms of alarm or nervousness; so putting on an air of unconcern, we take hold of the ladder and put our foot upon the round, and commit ourselves to fate and the guidance of the captain who precedes us.

Down, down, down we go, step after step, grasping with our hands each round of the ladder, fearing to trust our feet, lest they might slip. On all sides the cold, dark and icy rock is around and above us, seeming ready to fall in and crush us, creating a sensation of oppressiveness; but on we go, changing from one ladder to another, until at last we reach the lowest *level*, where we wait for our party to collect, and prepare to follow our guide through the narrow galleries of the mine.

Here it is proper to remark, for the benefit of some of your readers, that the *galleries* or *levels* are horizontal, running as nearly as may be on the vein, and meeting the several shafts that may be sunk from the surface. These levels must serve as roads or paths, on which the mineral is carried to the foot of some shaft to be taken out; and also for the purpose of ventilation, which is one of the most serious matters about the construction of a mine, for 60 or 100 men, with as many candles, together with the quantity of powder burned in a mine, would soon destroy all the oxygen of the air, and no one could live; finally, these levels serve another purpose in the economy of a mine, for they are extended as *feelers*, in any direction, to explore the character and value of the rock through which they are carried.

It would be impossible to give a correct idea of the first impression one receives of a mine, when, with candle in hand, he stands at the foot of the shaft and looks out and around in that deep-down pit. Ahead we hear the constant click click of the pick and the drill, and see men in their peculiar dress at work in all positions, and all around us the solid rock seems to our unaccustomed mind to threaten instant ruin. In some places we are compelled to stoop down half bent, and again, in others we can walk upright, and then we must creep through holes just large enough to admit the body, and then pass into a large excavation, where there may be a company of miners *stoping;* that is, blasting off and throwing down the vein-bearing rock from over-head.

As we go on, we see a wheel-barrow loaded, on its way to the foot of the shafts, perhaps, with a candle stuck upon it; and presently it comes back empty, with the candle stuck upon the forward part. We find a party of miners at work here, with the everlasting tallow candle burning on the front of

their cap, stuck there in a socket of moist clay; and another party at work drilling a hole, with their tallow candles sticking fast to the rock beside them, and all covered with dirt, and undistinguishable, reminding one more of a prison house of *Genii* than any place of human labor.

As we walk along, the Captain proudly points out the copper to us with his *tallow candle*, but it all looks alike to our eyes—it's all rock. A blow of the hammer upon the rock, however, sets us all right again, and the copper is discovered, sparkling among the quartz and rock, and in lumps of all sizes. Here and there along the side of the gallery, we were shown ragged looking fragments of copper sticking out from the rock—and the Captain soon calls us to see a *mass*, that looks very much as though it was an ordinary piece of stone and fully within the lifting power of any of us, but the attempt soon convinces us that instead of fifty, it weighs about five hundred pounds.

We find several masses weighing eighteen hundred pounds, and others one thousand; these have been taken out and are now above ground.

We follow our guide over heaps of mineral, thrown down from the stopes above, and being taken to the shaft to be hoisted out.

The Captain, as we pass along, rapidly points out here and there the vein as it hangs over our heads, or in the rock by our side, supposing we all have the same eyes he has. I begged of him to stop and show us the vein, and pointing with his candle, he exclaims, "Don't you see it?" Upon our replying in the negative, he gives the rock several blows with his hammer, that shows us the sparkling treasures mingled with the quartz and other material, lying between the two walls of Trap Rock, whose smooth surfaces upon each side indicate the width and size of the vein.

We now begin to see for ourselves, and to learn the first letters of the mining alphabet, when all at once comes a terrible cry of fire, fire! which is a signal to the miners that a blast is ready to be lit. Being out of danger, as our guide says, we wait in suspense for the explosion. The shock nearly takes away our breath, and putting out half our candles, we are comparatively in the dark. After re-lighting, our composure and courage is partly restored, and we are glad our guide is ready to begin our upward march.

We are led through the second level and shown the cross-cuttings and drift, and from thence we go up the ladder with a light step, and as we approach daylight again feel a grateful, enlivening sensation of satisfaction, and wewalk down to the office with a strong impression that *a copper mine is a great institution.*

Above ground the surface improvements are in good system of operation.

A copper mine necessarily includes within itself a village and farm. Sixty-seven men are engaged at this location and many of them have families, and must therefore have a house in which to live, have their comforts, and make a home; and the force at present employed is not much more than half that usually employed. They are arranged as follows:

There are 38 *miners*, whose entire business is excavating under ground, one half during the day, and the other half during the night, so that with the exception of the hours for meals, there is no cessation of labor from Monday morning until Saturday night.

There are 14 *laborers*. These are employed on the surface in various capacities, such as shovelling the refuse material to its place in the *burrow;* pushing the car on the tram-road from the mouth of the shaft to end of the road, where it is dumped, and other necessary employments around the different shafts.

There are 3 *men* employed at the stamps.

There are 2 *men* employed in burning the kilns, when the *copper bearing* rock is subjected to heat, and the small pieces of copper are detached, and afterwards put into *barrels*, and thus shipped to the smelting furnace.

There are 10 *men* engaged in chopping wood during the winter, and in doing the work necessary on the cleared lands, and gathering the proceeds of the farm.

This farm consists of forty acres of land, that has been cleared as occasion required; and from which was raised this year 1,600 bushels of potatoes, 800 bushels of turnips, 35 tons of oats and hay, that was cut together for feed, and 5 tons of hay alone.

Every year *eight acres* are cleared and added to this farm, for the establishment consumes each year what wood grows on eight acres of land.

There are 2 boarding masters, who board all the employees connected with the mine, who have no families; each master having a house suitable for his accommodation. All the arrangements and appointments are under the control of the Superintendent, to whom the boarding masters look for their supplies at stipulated prices.

There are two carpenters and two sawyers, and, as there is no saw mill, these sawyers must saw all the lumber used.

The stamps used at this mine are driven by water. A branch of the Fire Steel River furnishes the power that drives eight head of stamps, about two thirds of the year; a sufficient time to accomplish all the reduction of rock necessary at present.

There is a great saving in the use of water, and all the appointments about the building are such, that no degree of cold has yet, for two winters, suspended their stamps. This is quite an anomaly to the apprehension of the ordinary observer, but by *preventing the circulation of air* about the water wheel, all the difficulties attendant upon the use of water as a motive power are obviated, and have not been experienced. In consequence of this economy, only *three men* are required to keep the stamps in motion and do all required to be done at the stamp house.

The buildings are arranged with a view to good order and convenience, being on each side of a street, except the stamp house, which is on the stream, a distance of perhaps one eighth of a mile from the mine.

There are 1 office and warehouse, 2 boarding houses, 1 dwelling for mining captain, 1 officers' house for Sup't, &c., 1 carpenter's shop, 2 stables and barn, 1 changing house for the miners, 5 log houses, 2 root houses and cellars, 1 blacksmith's shop, 1 whim house, 2 shaft houses, 1 powder house.

Ridge Mine. The Report of the Superintendent of this mine contains the following particulars:

Clark shaft has been sunk 354 feet from surface, and Hanna shaft 321 feet from surface; both on the course of the lode, and 301 feet apart. Four drifts have been driven from shaft to shaft, and east of Hanna and west of Clark shaft.

The first (1st) drift at (Clark shaft) is 77 feet; and at (Hanna's shaft,) 84 feet from surface.—The 2d drift is 65 feet below the first. The 3d is 64 feet below the second, and the 4th is 68 feet below the third level; showing Clark shaft 80 feet below the fourth level, and Hanna shaft 40 feet below the fourth level. A winze, or rather a rise from the third to the second level has been opened, for the advantage of stoping; and a little west of the rise, in the third level I have started a winze to sink, for the advantage of stoping also. The character of the lode is somewhat peculiar, not having any defined walls. The dip of the lode is about 45 degrees to the north, and bearing by the needle north, 40 east. The declivity of the lode is as regular as any other; and like most master ones, increases in copper as we go in depth. It varies in width from 3 to 9 feet, and may be estimated as an average, at 5 feet wide. It will be seen on reference to the section, that a slide passes through the mine, and that a run of productive ground exists before it and increases in depth. A gradual improvement may be seen throughout the mine as we proceed in depth; showing the propriety of opening the mine in that direction. In order to do which, a steam engine has been ordered and landed on the pier, at Ontonagon; but, unfortunately, some important parts were lost by the late storm,

viz.: the cylinder, one box of machinery, and pitman. Efforts are being made to restore those, as it will have a very important effect on the mine, for the ensuing year.

The machinery now at work on the mine consists of one steam stamp, lifting 12 heads, and 12 more are in progress of erection, contemplated to start by the first of November.

Resources for the stamps consist of 40,000 tons of copper stuff, now on the surface; and by reference to the section it will be seen that considerable productive ground is now opened for stoping.

The amount of copper raised and forwarded to market up to this date, is 16 tons, 10 cwt., and 96 lbs. These returns will now be more regular as soon as our machinery is got into full operation.

Improvements on the mine, consists of 18 dwelling houses, 1 steam engine, 1 saw mill, 1 stamp, and 2 horse whims, 1 smithy, 3 stables, 1 office, 1 warehouse, 2 root houses, and 1 magazine. Total of buildings, 25 houses.

Of live stock, we have 6 horses, 5 yoke cattle, 2 cows, 12 pigs, 12 sheep.

Agricultural products as follows, for the past year:

10	acres of hay,	computed	8 tons	at	$40	$320
2	" oats,	"	8 "		50	150
10	" potatoes,	"	1,500 bush.	"	1	1,500
1	" turnips,	"	100 "	"	75 c.	75
23			Total,			$2,045

The force employed on the company's property, consists as follows:

Miners, 20; mining laborers, 8; surface laborers, 12; stamp dressers, 6; engineers, 2; smiths and helpers, 4; carpenters, 5; cutting out road from mine to plank road, 8; agents, 2; clerk, 1; barrelling copper, 3. Total, 71.

These embrace the general features of our operations, from which, it will be seen that the prospects of the mine are encouraging. That the erection on the property, with that contemplated to hoist the copper stuff and dirt, out of the mine, together with the conveniences, are adequate to work the mine to a considerable extent. Competent judges are of opinion that the prospects now before us warrant the expectation to pay current expenses in course of the ensuing year.

The amount of copper above named, includes only what we have raised last summer.

DISTANCE FROM COPPER HARBOR TO ONTONAGON.

The subjoined table will show the distance and length of the road:

Names of places.	Present state of the route.	Dist. from places.	Total distances.
Copper Harbor,		—	—
Empire Mine,	Wagon road,	4	—
North-West Mine,	Bridle path,	8	12
N. Western do.	Winter road,	4¼	16¼
Forks Eagle River,	Wagon road cut and partly graded,	5	21¼
Fulton Mine,	Rough wagon road,	10	31¼
Washington Mine,	Bridle-path,	5	36¼
Pewabic and Port Lake,	Winter trail,	12	48¼
Erie and Ontario,	Foot-path,	18	66¼
Douglass Houghton,	Bridle path,	14¾	81
Toltec Mine,	Good road,	5	86
Minnesota Mine,	No road,	8	94
Ontonagon River,	Good road,	2	96

Making a total of ninety-six miles from Copper Harbor to the Ontonagon River at the Minnesota landing, and about 110 miles to the Norwich mine, and 120 to Gogebic Lake, where its present terminus ought to be. The distance to Ontonagon city, via Toltec mine, would be 102 miles only.

EVERGREEN BLUFF AND CAMBRIAN MINES.

The last mail from Lake Superior brought numerous letters from the mines, from which we have taken the following extracts:

ONTONAGON, *February* 25, 1855.

TREASURER EVERGREEN BLUFF MINING CO.:

"DEAR SIR—The mine looks first rate—the miners are continually taking out copper. The end of the drift is looking well. We will probably ship about five tons of copper next spring, which is doing well. We now have eight men employed.

Yours truly,
EDWARD SALES, Agent.

Mr. Daniel Edwards, agent of the Cambrian Mine, and the pioneer in the Montreal River mining districts, writes from Ontonagon, under date of January 18, 1855, as follows:

"I have just arrived from the Cambrian Mine, and have but little news to write. I have got the road cut through, and have built a temporary house for this winter. Timber is so scarce that I cannot build a good one without a team. I have not done any work on the 'big vein' yet, on account of not having powder, and have come down for the purpose of procuring some, and have purchased it from the Black River Co., and shall return to-morrow, when I shall open the vein. I have discovered a good looking vein near the 'old building;' it is composed of epidote and quartz, running north and south. I have run out the lines of the location, and find that we extend nearly a quarter of a mile above the Falls. The big vein commences at the Falls, and continues through the corner of the location, and makes into the river again."

Mr. Joseph Coulter, Superintendent of the Douglass Houghton Mine, writes as follows:

ONTONAGON, *February* 12, 1855.

"Yesterday we had the pleasure of receiving the first overland mail from your city: though it brought us bad news, nevertheless it was a welcome messenger. Some mines have had their drafts protested and returned by mail* (but none to your humble servant). This is to be regretted, and bad for the mining interest, when we take into consideration the present very flattering condition of many of the Companies that are suffering their paper to lay over. Now is the time for a man to make a strike out of the country by making *judicious investments* in the very low-priced stocks, that are being offered upon the market.

"The mines in this immediate neighborhood never looked so well as now. I have already hauled from this mine some 30 tons of copper to Ontonagon, and shall have several tons ready for the teams.

"Our friend Sales passed here yesterday on his way home from Portage Lake, where he had been to get through, on *dog trains*, some castings for his Stamp Mills."

* We do not learn that any of the Mining Companies, whose officers are located in Detroit, have failed to meet the drafts of their agents, though we learn that some eastern companies have done so.

COALS AND COLLIERIES.

ANTHRACITE COAL TRADE for 1855.

Amount shipped from Richmond to March 31st,	226,865	tons.
Last year,	190,234	"
Increase,	36,631	"
Amount sent by Reading Railroad to 4th April,	508,759 12	"
" " Schuylkill Canal,	76,597 03	"
Total,	585,356 15	"
Same time last year,	513,022 16	"
Increase in 1855,	72,333 19	"

No coal had been shipped from the Lehigh region up to April 6th—nor from the Delaware and Hudson region.

CUMBERLAND COAL TRADE for 1855.

Over the George's Creek Coal and Iron Company's Railroad were shipped for the week ending March 31st 4,267,17 tons, and for the year commencing January 1, 1855, 85,994,08, more than was conveyed by the whole coal region for the same time last year.

The Cumberland Coal and Iron Company shipped for the same period, 2,120,11 tons for the week, and 16,928,01 tons for the year commencing same time, of which 834,10 tons went by railroad, and 1,286,01 tons by canal.

Over the Cumberland and Pennsylvania railroad there was shipped to market 3,399 tons, of which 1,542 tons went by railroad, and by canal 1,857 tons. The coal transportation so far gives the belief that a good business will be done this season.

REPORT OF THE DELAWARE AND HUDSON CANAL COMPANY.

The Managers of the Delaware and Hudson Canal Company, herewith furnish to the Stockholders the usual annual statement of the year, terminating on the first of the present month, by which the amount of net profits is shown to be $1,100,141 79, equal to fifteen and a quarter per cent. on the capital stock of the Company.

The quantity of coal shipped from Honesdale during the season was 438,406 tons, of which 412,549 tons either reached Rondout, or was sold at various points along the line of canal; the remainder, 25,857 tons, having been detained on its downward transit by the premature and unexpected closing in of the winter.

An item of $541,378 07 will be found on the credit side of the statement, being the amount received from the Pennsylvania Coal Company, in part payment of tolls on the coal cleared by that Company from Hawley.

The business of the past year was marked by extraordinary interruptions to the navigation of the canal, which, while they lessened the quantity of coal that would otherwise have been brought to market, at the same time largely added to the cost of production. The very favorable result which, under such circumstances, the Board are still able to present is, they think, well calculated to strengthen the confidence of the Stockholders of the Company in the substantial value of their work.

It has been the misfortune of the Board, since the issuing of the last annual report, to be deprived of the invaluable services of one of their fellow members, MAURICE WURTS, Esq., whose lamented decease occurred on the 29th day of December last. The name of Mr. WURTS has been identified with the history of this Company during the whole term of its existence; its earliest inception originated with him; he was unceasingly and faithfully devoted to its interests, both as an executive officer and a manager, and, until the period of his last illness, the Company never failed to derive profit from his astute counsels and active and energetic exertions. By order of the Board,

WM. MUSGRAVE, *Vice President.*

New York, March 27th, 1855.

Statement of the business of the Delaware and Hudson Canal Company, for the year ending March 1, 1855.

DR.

To Coal on hand, March 1, 1854,		$337,644 23
" Mining Coal,		408,481 19
" Railroad transportation and repairs,		293,506 19
" Canal repairs and superintendence, including extraordinary repairs consequent upon freshets,		281,233 82
" Freight of coal to Rondout,		446,575 61
" Labor and expenses at Rondout,		60,945 10
" Rents, salaries, current expenses, &c., New York office,		26,575 96
" Coal Yard and Harber expenses, Taxes, Interest account, &c.,		129,650 91
" Depreciation account,		87,246 75
Balance,		1,100,141 79
		$3,172,001 55

CR.

By sales of coal,		$2,398,442 78
" Canal and railroad tolls,	$45,971 45	
" Tolls from Pennsylvania Coal Company,	541,378 07	
		587,349 52
" Barge profits,		21,17 25
" Coal on hand, being principally in pile at Honesdale and Weymart, and in boats on line of canal,		184,092 00
		$3,172,001 55
Balance,		$1,100,141 79

ISAAC N. SEYMOUR, *Treasurer.*

New York, March 1, 1855.

From the above table it appears that the expense of mining coal last year was 93 cents per ton, put in the cars; railroad transportation, including repairs of road, from Carbondale to Honesdale, 66 cents; freight to Rondout, $1 01¼, and freight from Rondout to New York, 23 cents—making the actual cost of mining and delivering coal at New York, independent of repairs to canal, towage from Rondout to New York, coal leave, and profits of investment, $2 84—transportation alone, $1 85 per ton for a distance of about 212 miles. The profits on a business of 438,406 tons of coal is set down at $1,100,141 79—equal to $2 50 per ton on the investment for repairs, &c., and for dividends. The amount of the capital stock is not given in the report.

THE TRANSPORTATION OF COAL ON RAILROADS.

We publish the following abstracts of the business of several railroads built exclusively for the transportation of coal, as important to show the results from that kind of freight, both as to expenses, profits and costs.

Abstract of the accounts of the Mount Carbon Railroad Company, February 1, 1855.

Dr.

To capital stock, as per statement of February 1, 1854, 3,560 shares, at $50 per share, . .		$178,000 00	
Since issued in distribution to stockholders, 440 shares, at $50 per share, . . .		22,000 00	
			$200,000 00
To amount of debts due by the company, ...			581 25
To amount of profits from Feb. 1, 1854, to Feb. 1, 1855, made up as follows:			
Tolls—net receipts on 174,951 tons, 16 cwt., 2 qrs. coal,		$17,036 58	
Interest received, ...		142 53	
		17,179 11	
Deduct repairs of road, . .	3,441 63		
Deduct expenses in Schuylkill co., and Phila.,	477 38		
		3,919 01	
		13,260 10	
Deduct dividend declared Nov. 15, 1854, 6 per cent. on $178,000, .	10,680 00		
State tax of 5 per cent. on $10,680, .	534 00		
		11,214 00	
		2,046 10	
Add balance of profit and loss, per statement of Feb. 1, 1854, ...		20,391 90	
		22,438 00	
Deduct issue of stock in distribution, 440 shares, at $50 per share, .	22,000 00		
Deduct commutation in cash for fractions of shares in distribution account, .	250 00		
		22,250 00	
			188 00
			200,769 25

Cr.

By Mount Carbon railroad, cost to Feb. 1, 1854,		195,162 30	
Since expended for its improvement, . . .		808 12	
			$195,970 42
By materials and personal property on hand, per inventory and valuation, ...		534 40	
By cash in the treasurer's hands, . . .		527 02	
By amount of debts due to the Company, . .		3,787 41	
			4,264,43
			200,769 25
By profit and loss, balance February 1, 1855, . . .			188 00

JOHN R. WHITE, *President.*

Abstract of accounts of the Mount Carbon and Port Carbon Railroad Company January 9th, 1855.

Dr.

Railroad and real estate,	$234,671 88
Construction account,	40,833 30
Sundry debtors,	2,282 22
Cash,	353 89
	278,143 29

Cr.

Capital stock,	$235,700 00
Revenue account,	26,204 68
Dividends unpaid,	2,576 75
Bills payable,	11,236 91
Sundry creditors,	1,600 00
State tax,	824.95
	278,143 29

Revenue statement for the year 1854.

January 1854, revenue surplus,		$1,996 27
Tolls on 622,544,13 tons coal and 5,200 tons merchandise,	$35,258 66	
Rents of buildings, tracks, &c.,	20,260 45	
Interest,	748 93	
		56,268 40
Total credits,		58,264 31
Less expenses for the year 1854.		
Repairs,	$13,246 48	
Office expenses, salaries, &c.,	1,489 20	
J. C. Oliver's debt,	623 43	
		15,359 11
Net revenue for the year,		42,905 20
Appropriated for July dividend, 1854, 7 per cent and tax,	17,323 95	
Appropriated for January dividend, 1855, 8 per cent and tax,	19,798 80	
		37,122 75
Revenue surplus,		5,782 45

JOHN TUCKER, *President.*

Abstract of accounts of the Schuylkill Valley Navigation and Railroad Company, January 8th, 1855.

Dr.

Railroad,	$555,283 47
Cash and demand loans,	40,663 01
Collector,	1,147 07
Sundry debtors,	5,887 10
	602,980 65

Cr.

Capital stock,	$561,450 00
Revenue account,	33,939 34
Bills payable,	5,543 86
State tax,	998 40
Reading Railroad Company,	845 05
Dividends unpaid,	154 50
	602,980 65

Revenue statement for the year 1854.

January, 1854, revenue surplus,		$ 2,667 64
Tolls on 515,401,17 tons coal and 3,273 tons merchandise,	$61,028 89	
Gain on motive power,	8,770 91	
House and water rents,	289 17	
Interest, &c.,	194 71	
		70,283 68
Total credits,		72,951 32

Less expenses for the year 1854.

Repairs,	$15,390 15	
Rent to Mount Carbon and Port Carbon Railroad Co.,	1,500 00	
Office expenses,	1,505 43	
J. C. Oliver, debtor,	3,033 83	
		21,429 41
Net revenue,		51,521 91
Appropriated for July dividend, 1854, 4 per cent and tax,	$20,966 40	
Appropriated for Jan. dividend, 1855, 5 per cent and tax,	29,476 13	
		50,442 53
Revenue surplus,		1,079 38

John Tucker, *President.*

Abstract of accounts of the Mill Creek and Mine Hill Navigation and Railroad Company, January 6th, 1855.

Dr.

Railroad and real estate,	$292,575 00
Construction account,	3,277 07
Cash and demand loans,	19,661 26
Collector,	79 87
	315,593 20

Cr.

Capital stock,	$292,575 00
Revenue account,	19,490 35
Dividends unpaid,	62 90
Bills payable,	2,369 67
Philadelphia and Reading Railroad Company,	464 08
Tax on July dividend,	631 30
	$315,593 20

Revenue statement for the year 1854.

January 2, 1854, balance to credit of revenue account,		$924 51
Toll on 461,205 tons of coal and 3,543 tons merchandise,	$35,126 23	
Receipts for motive power,	21,700 03	
Total,		56,826 26
Total credits,		57,750 77

Less expenses for 1854.

Rent to Mount Carbon and Port Carbon Railroad Co.,	$ 2,500 00	
Repairs,	7,702 23	
Cost of motive power,	10,740 20	
Office expenses—salaries,	4,055 20	
Interest—balance of account for the year,	5 54	
		25,003 17
Net revenue for the year 1854,		32,747 60
Appropriated for July dividend, 1854, 4½ per cent and tax,	$13,257 35	
Appropriated for Jan. dividend, 1855, 6 per cent and tax,	18,432 22	
		31,689 57
Revenue surplus,		1,058 03

John Tucker, *President.*

Abstract of the accounts of the Mine Hill and Schuylkill Haven Railroad Company.

On the first day of January, 1855, the capital stock of the Company consisted of thirty thousand five hundred shares, as per certificates issued, amounting at the par value of fifty dollars per share, to $1,525,000. Of this amount two hundred and forty-six shares are held by the Company.

In addition to the stock issued, there are outstanding certificates of loan, due by the Company, amounting to $300,000.

The income of the Company, for the year 1854, has been derived from the following sources, viz:

For tolls and the use of motive power in the transportation of coal and merchandise, 1,181,726½ tons, with the Company's share of the passenger business,		$308,109 92
Less abatements made by the board,		16 87
		308,093 05
For balance of interest received and rent of tenements,		108 54
Making the income of the year,		308,201 59
The current charges have been for fuel, wages, repairs, oil and other expenses of the motive departm't,	$92,705 47	
For salaries of officers and current expenses in the repair and maintenance of the road, rent of office and incidentals,	44,283 98	
		136,989 45
Leaving as the balance of profits for the year 1854, the sum of		171,212 14
A dividend was declared in August, 1854, of 7 per cent upon the capital, at that time $1,000,000,	70,000 00	
And one in Jan. 1855, of 5½ per cent upon $1,512,700,	83,198 50	
The balance, $12,300, is held by the Company, and on this portion no dividend was declared.		
The State taxes on these dividends, have been paid to the State Treasurer, amounting to	7,659 93	
		$160,858 43
Leaving a balance of		$10,352 71

Which has been appropriated to the depreciation, or repair fund.

SAMUEL MASON, *Treasurer.*

JOHN C. CRESSON, *President.*

General account of the Little Schuylkill Navigation, Railroad and Coal Company, for the year ending December 14, 1854.

Dr.

To lands with colliery improvements, slopes, shafts, tunnels, stationary engines at saw mill, planes and collieries, landings at Port Clinton, with all improvements connected with the mining and shipping of coal in Schuylkill County,	$1,353,198 69
To railroad from Port Clinton to Tamaqua, with extension of road to the junction of Catawissa road, including lateral roads to the various mines, sidings, engines, car houses, water and wood stations, scales, and freight depots, offices, and all other improvements connected with the road,	1,273,018 49
To real estate, including buildings and lots at Tamaqua, Newkirk, Ringgold, Reading, Port Clinton, &c.	207,569 90
To general inventory of property, including locomotives, coal, freight and passenger cars, tools, horses, and all other moveable property,	155,170 64
To cash,	33,960 11
To bills receivable,	209,965 04
To sundry amounts due Company by operators at Tamaqua, and others,	153,184 58
	$3,386,067 45

Cr.

By stock, 41,919 shares,	$2,095,950 00
By stock to be issued in payment of bills receivable,	169,550 00
By loans—mortgage loan of 1860,	500,000 00
By bills payable, and sundry accounts,	406,907 44
By interest on loans, with sundry amounts due by company,	32,788 28
By profit and loss,	95,537 18
By sinking fund,	85,389 60

Geo. W. Cole, *Secretary and Treasurer.*

F. N. Buck, *President.*

COAL STATISTICS.*

Relation of Iron to the Coal Trade.

The certain and gradual diminution of the materials of the forest is increasing the annual demand of coal for the manufacture of iron. The interesting fact is presented by the following table, that in North America, the consumption of iron per head is greater than in any other nation on the globe. Mr. C. F. Woern, a member of the Swedish diet, on a motion to repeal taxes on pig iron, said that all kinds of iron being reduced into pig iron,

In North America, the consumption is		88 lbs.	per head.
Great Britain,	"	81	"
France,	"	36	"
Hanover and Oldenburgh,	"	29	"
German Customs Union,	"	24	"
Switzerland,	"	18	"
Sweden,	"	11½	"
Austria,	"	11	"
Russia,	"	8	"

Estimate of the quantity of coal that would be required to make iron for railroad car-wheels in the United States, assuming that the American railroad system (i. e., the roads finished, progressing, and being engineered in 1854) *were now completed, or that the wheels of the rolling stock required renewal triennially.*

The estimate of miles in the whole system has been variously estimated, some over and some below the following estimate, which is taken from data furnished at one of the departments at Washington, and is probably accurate. It is safe to estimate practically eight tons of coal to manufacture one ton of wrought iron, one and a half tons of coke for one ton of cast iron, and three tons of coal for one and a half tons of coke.

Railroads finished,	13,219	miles.
" progressing,	12,928	"
" being engineered,	7,000	"
	33,147	

The railroad system is probably more practicably and eco-

* Continued from page 207, vol. IV.

nomically developed in New York and Massachusetts than in any other States of the Union. The *average* of these two States is taken for our estimates. The rolling stock for these States averages as follows:

locomotive for	each 4·08	miles of road, or	8,124	for 33,147	miles of RR.
1 passenger car	" 2·849	" "	11,599	"	" "
1 freight car,	" ·2919	of a mile, or	113,550	"	" "

In this estimate, "freight cars" include gravel and baggage cars; and to render the estimate safe, the driving and pilot wheels are all reduced to bearing wheels.

The railroad system requires for wheels for locomotives and tenders,	129,984
Passenger cars,	92,792
Freight, as above,	908,400
Total wheels required,	1,131,176

A railroad bearing-wheel weighs about 500 pounds. 1,131,176 wheels, at 500 pounds, require 565,588,000 pounds of iron, or 282,794 tons of 2,000 pounds. It will consequently require (at three tons of coal per ton of iron) 1,063,382 tons of coal to make iron for railroad wheels once in three years, or about one ninth of the whole United States' production for 1854, which is estimated, including the Western States, at 9,207,563 tons.

Quantity of Coal received in Boston.

	1853.	1852.
Anthracite, tons,	431,270	362,006
Virginia, bushels,	14,000	4,600
Foreign coal, chaldron,	40,764	46,068
" tons,	9,343	5,292

Consumption of Coals in England.

	Tons.
Consumption of Coal in London annually,	3,700,000
" " Liverpool, "	1,300,000
" " Manchester, "	1,430,000
" " Preston,	500,000
" " Glasgow,	1,700,000
" " surrounding neighborhood of Glasgow,	3,000,000
" " Iron districts of Wales,	4,500,000

In Prussia, the yield of coal in 1852 was 3,223,533 tons, valued at $8,856,692, and mined by 36,444 miners.

Consumption of Coal on Western Waters.

Estimate of Western coal used on Western waters:

	Bushels.
Steamers, ...	9,000,000
Sugar-houses (1437 in Louisiana alone), .	11,000,000
New Orleans City consumption, . . .	2,350,000
" " for steam marine, . .	3,650,000
Towns and cities on rivers, ...	3,429,624
General Government supplies on Gulf, .	3,000,000
	35,000,000

Or 1,206,896 tons.

Consumption of Coal in Cincinnati.

1840, ...	24,000 tons.
1846, ...	82,000 "
1852, ...	170,000 "

According to Mr. Haupt, the following amounts of coal are used in the home consumption of Pittsburgh Western coals from the Western bituminous basin:

For domestic uses, ...	12,000,000
" rolling mills, ...	6,375,000
" foundries, ...	540,000
" glass houses, ...	600,000
" engine and machine shops, ...	600,000
" cotton factories, ...	100,000
" gas works, ...	200,000
" public buildings, ...	150,000
" miscellaneous engines, &c., ...	900,000
" steamboats, ...	840,000
Pittsburgh consumption, bushels, . . .	22,305,000
Exported from Pittsburgh to other places,	14,403,921
Bushels, ...	37,708,921
Tons, ...	1,346,711

Importation of Foreign Coals,

According to the returns of the U. S. Treasury Department, and report to the Senate of Pennsylvania.

	Tons.	Official Value.	Duty.	Average Price in New York.	Gross Value.
1789,	3,850				
1795,	4,477				
1800,	11,787				
1805,	17,805				
1810,	14,080				
1814,	691				
1815,	3,514		$3 60 per chal.	$23 00 per chal.	
1820,	24,061		1 80 "	11 00 "	$108,257
1825,	25,645	$108,527	2 16 "	14 00 "	
1830,	58,136	204,778	2 16 "	14 00 "	204
1835,	49,960	143,461			
1837,	153,450				
1839,	181,551				
1840,	162,867	387,238			
1842,	141,521		1 75 per ton.	7 16 per ton.	
1843,	41,163	116,312			
1844,	87,073	208,681	30 per cent.		
1845,	85,726	187,962	"		
1846,	146,858	336,691	"	7 00 "	
1847,	148,021		"		
1848,	196,168	426,997	"		
1849,	198,213	382,254	"		
1850,	180,439	361,855	"		
1851,	214,774	478,095	"		
1852,	188,015	405,652	"		
1853,	231,508	490,010	"		
1854,	252,865				

Average Weights of a Cubic Yard of American, European, and Asiatic Coals.

(From Taylor's Statistics of Coal.)

	Bituminous.	Anthracite.	Intermediate Species.
Mean weight of the American,	2,560 lbs.	2,601 lbs.	2,475
" European,	2,164 "	2,281 "	
" Asiatic,	2,277 "		

Customs, Weights, and Measures of Coals at Different Places.

Ordinary estimate of bituminous coal, 28 bushels, equal to 1 ton of 2,240 lbs.

At the West, it is often sold by 26½ bushels, equal to 1 ton of 2,240 lbs.

At Richmond (Va.) coalpits, 5 pecks are sold to the bushel.
" " bushel weighs 90 lbs.

At the South, bituminous coal is sold by the barrel, weighing 172½ lbs., equal to 13 barrels to 1 ton.

A New York ton is 2,000 lbs.

On the canals the coal is charged per 1,000 lbs.

Foreign bituminous coals are commonly sold by the chaldron, of 36 bushels, weighing 25½ cwt.

A Nova Scotia chaldron is 1¾ tons, or 3,960 lbs. of 42 bushels, but the measurement yields 42 bushels.

The official returns to Congress comprehend all bituminous coal throughout the Union (be their specific gravities what they may), at 80 lbs. to the bushel, and 28 bushels to the ton.

In Boston, a retail chaldron is commonly 2,500 lbs.

Areas of Coal Fields in the United States and Europe.

	Square Miles.	
Alabama,	3,400	
Georgia,	150	
North Carolina,	150	
Tennessee,	4,300	
Kentucky,	13,500	
Virginia,	21,195	
Maryland,	550	
Ohio,	11,900	
Indiana,	7,700	
Illinois,	44,000	
Pennsylvania,	15,437	
Michigan,	5,000	
Missouri,	6,000	
British America,	18,000	
Great Britain,	8,139	Bituminous.
" " and Ireland,	3,720	Anthracite.
France,	1,719	
Belgium,	518	
Spain,	3,408	

Proportion of Coal Areas to the Whole Number of Square Miles in given Countries.

Great Britain,	$\frac{1}{10}$	of whole area.
France,	$\frac{1}{200}$	"
Belgium,	$\frac{1}{22}$	"
United States,	$\frac{1}{17}$	"

Probable Annual Production of

	Tons.
British Islands,	37,000,000
Belgium,	5,000,000
France,	4,200,000
Prussia,	3,500,000
Austria,	700,000
Spain,	550,000
United States,	9,207,563

Consumption of Coal by Steamers.

If all the steamers registered in the United States should use coal, (and they must ultimately do so,) they will create a consumption that will draw heavily upon the annual production of the country.

According to the U. S. Treasury Report, the steam marine of the United States, up to 1854, was as follows:—

Steam Marine of the U. S.

	No.	Tons.
Atlantic Coast, East of Cape Florida, . . .	465	154,270
Gulf of Mexico, from Cape Florida to Rio Grande,	109	23,244
Pacific Coast, ...	51	34,986
Miss. Basin, exclusive Ohio Basin, ...	253	65,957
Ohio River and Basin, ...	348	6,760
Basin Northern Lakes, ...	164	69,168
	1,390	416,226

	No.	Tons.
Ocean Steamers, ...	96	91,475
Ordinary "	1,045	275,000
Propellers, ...	119	27,974
Ferry Boats, ...	130	22,744

Average.

Ocean Steamers, ...	953	tons	average
Ordinary do., Coast, ...	235	"	"
Do. do., Lakes, ...	503	"	"
Do. do., Rivers, ...	235	"	"
Propellers on Coast, ...	180	"	"
Do. Lakes, ...	302	"	"

It is impossible to procure precise results from averages reduced from the above numbers or tonnage. Ocean steamers consume profusely, and ferry boats economically for the power obtained. The ordinary or river boats, perhaps, afford the safest criterion for estimating the consumption of coal. A first class Western river boat will run from Louisville to New Orleans, (1400 miles,) in 7 days, or 14 days for the round trip of 2800 miles, and consume in that time 1,100 cords of wood, or $\frac{1393}{1000}$ of a cord per mile. Allowing for the usual number of trips and lay days per year, and 1 ton of coal as equal to $2\frac{1}{4}$ cords of wood, the aggregate consumption by steamers, (on the supposition that they will all use coal,) will be 1,835,649 tons. The actual consumption will, no doubt, greatly exceed this estimate. It, however, affords some idea of what position the American coal trade is yet destined to occupy among the industrial interests of the country.

ORDERS, RULES, AND REGULATIONS TO BE OBSERVED BY THE WORKMEN,*

And all others concerned in the working of the Castle Eden Colliery, *the property of the Castle Eden Coal Company, England.*

SAFETY-LAMPS.

46. No workman is allowed to use a safety-lamp in the whole mine, nor in the pillar-working, or broken, without its having been first examined by the overman, or deputy, and securely locked; nor in the waste, without its having been first examined and securely locked by the master wasteman; and the hewers, or any other person, using a safety-lamp, are particularly enjoined to attend to the directions given by the overman, inspector, or deputies, as to how they are to use their lamps during the time of working. No lamp to be used on which there is not a tin or other shield. None but the overman, deputies, or master wasteman, are allowed to carry a lamp key.

47. Should any accident happen to a lamp while in use, by which either the oil is spilt upon the gauze, or it is in any other way rendered unsafe, it is immediately to be extinguished by drawing the wick down with the picker, and taken outbye, to the station fixed upon by the under-viewer (on the inbye side of which candles are not to be taken), and not again used until after having been properly examined by the deputy.

48. Should any workman using a safety-lamp detect by the usual indications the appearance of fire-damp, he is immediately to extinguish his light by drawing the wick down with the picker, then to retreat to a pure atmosphere, and give notice of the same to the overman or deputy in charge of that department of the mine.

49. The hewers, or any other person, to whom a safety-lamp is intrusted, are strictly prohibited from interfering in any way whatever with the lamp, beyond the necessary trimming of the wick with the picker.

50. Should any hewer, putter, or any person whatever, who is in charge of a safety-lamp, in any case lose his light, he is to take it himself to the station where the lamps are examined, to be relighted, and is not allowed to send it out by any other person; and when relighted it is to be examined and locked by the deputy before being again used.

51. Smoking tobacco is not allowed in any part of the mine where safety-lamps are used, and persons offending against this order are liable to be fined 10s., or to be taken before a magistrate, at the option of the owners or viewer. One moiety of the fine to be paid to the informer.

52. No candle to be taken nearer to the broken, or pillar-working, than the station fixed by the under-viewer; any one found with a candle within that distance to be fined 10s. One moiety of the fine to be paid to the informer.

53. No putters, pony-drivers, or others, under any pretext whatever to carry a lamp during their work: lamps will be hung along the going roads, to afford sufficient light for the performance of the work.

54. Any person acting contrary to the above instructions, is liable to a fine of not more than 10s., or to be taken before a magistrate at the option of the owners or viewer; the fine to be paid to the informer; and it is particularly requested that any person witnessing any improper treatment of the safety-lamps by the boys or others, will give immediate information to the overman in charge of the pit, in order that proper steps may be taken to guard the lives of the people employed in the mine.

CAVILS.

55. Lots to be drawn amongst the hewers for the different pits, for the different seams, and for the different places in each pit, once in two months, to change at the end of the pay nearest the 5th January, the 5th March, the 5th May, the 5th July, the 5th September, and the 5th November, in each year.

* Continued from page 167, vol. IV.

56. When any man or set of men are required to remove from one pit or seam to another, during the two months, the man or set of men whose cavil is stopped are to be the first to remove.

57. If two or more men, or two or more sets of men, are required to remove at the same time, they have to draw lots for the places to which they are removed.

58. Any man or set of men that may have been removed on account of their cavil being stopped, are to go back in case their cavil is set on again before the period for which the cavils are in expires. If they have got a cavil during the time their own was stopped, it will be at liberty for the next set of men that may want one.

59. Any man or set of men wanting places at any time, when their own is stopped, or from any other cause claim places at their own flat before men belonging to another flat—that is, spare places, not cavils.

60. The first man or set of men wanting a cavil, are to have the first that is at vacancy.

61. Should a board be on in different pillars, the men belonging to it must claim next the face.

62. Each set of men must drive their own wall, and if on both sides, they have the choice of sides, but if on in different pillars they go next the whole.

63. In driving a pair of drifts or headways each set of men claims half the stainting, and should it have to be driven all from one side, still each set of men drives half.

64. Should the walls at any time require to be made thicker or thinner, each set of men claims the board turned nearest his own, and the additional places, in case the walls are made thinner, are to be additional cavils: and in case the walls are made thicker, the men losing cavils, claim according to the rules provided for that purpose.

65. Any man or set of men that may have a cavil, taking a bargain, return to their own cavil when the bargain is finished.

66. Lots to be drawn amongst the putters for the different ways, where putters are required, in each pit, once in two months, to change at the same time as the hewers.

67. The last putter cavilled to any way to be the first to remove to another when required, and when two or more are required to move at any one time, lots to be drawn for the ways to which they have to remove, if to more than one.

68. Should any putter or putters be required to remove to another pit or seam, or to change from one shift to another, lots to be drawn amongst the whole that may be in the pit, seam, or shift (as the case may be), from which they are to remove.

69. Lots to be drawn amongst the pony-drivers for the different ways where pony-drivers are required, in each pit once in two months, to change at the same time as the hewers.

70. The last pony-driver cavilled to any way to be the first to remove to another when required, and when two or more are required to move at one time, lots to be drawn for the ways to which they have to remove, if to more than one.

71. Should any pony-driver or pony-drivers be required to remove to another pit or seam, or to change from one shift to another, lots to be drawn amongst the whole that may be in the pit, seam, or shift (as the case may be), from which they are to remove.

UNDERGROUND HORSES AND PONIES.

72. Each horsekeeper to visit the horses and ponies under his charge, not less than once in every 12 hours; he is to have them all properly groomed, fed, and watered, and before leaving he is to see that no lights are left in, and that they are all in a safe, healthy state.

73. The horsekeepers are at all times to keep by them such medicines (in

proper doses) as are usually administered in cases of illness, viz., gripe-drinks, soothing-draughts, purging and diuretic balls, healing salve, &c.

74. In the case of any horse or pony taking ill, the horsekeeper is, so far as he can with safety, to administer such remedies as he may have in his power, but he is immediately to send for the farrier.

75. All horses and ponies to be examined by the farrier, at least once in each week, who is to report to the viewer any thing that may be amiss amongst them.

76. Any horse or pony losing a shoe while he is at work is to be loosed immediately, and not again yoked until such shoe be replaced.

77. It is the duty of each driver, or other person in charge of a horse or pony, to attend to such horse or pony during the time that he is in his charge, and at the close of each day's work, or on finishing the work required to be done, to conduct him to his stall in the stable, and deliver him to the horsekeeper; and should any accident happen to a horse or pony through the carelessness of the driver, or other person to whom he is intrusted, such person to be liable for the amount of damage done, which is to be deducted from the amount of his wages then due, or afterwards to become due.

78. Any person ill-treating a horse or pony is liable to a fine of not less than 5s., or to be taken before a magistrate, at the option of the owners or viewer. One moiety of the fine to be paid to the informer.

79. In sending the horses and ponies up and down the pit, it is the duty of the banksmen to attend them at bank, and the horsekeeper and onsetter at the bottom of the shaft, who are responsible for their safe netting, and the shaftman is responsible for their safe conducting up and down the shaft. It is the duty of the engineer to see that the horse and pony nets are repaired when necessary, and kept in a safe condition.

ENGINES AND ROPES.

80. The engineer to inspect the engines, machinery, and boilers daily; and it is the duty of the brakeman, or plugman, in charge of any engine, to attend constantly to such engine, (during his shift,) in order to keep it in a safe working state; and he is to pay particular attention to the safety-valves, and regulate the feed so that there may be a constant and regular supply of water to the boilers. Each boiler to be slagged twice in every 12 hours, and unplugged and cleaned as often as necessary, and so ordered by the engineer to be done. Any boiler considered in the least degree unsafe to be laid off immediately, in order that it may be repaired.

81. No brakeman is allowed to permit any other person to brake the engine under his charge without the consent of the viewer or engineer, and he is on no account to allow any learner or other person, to brake when men or boys are descending or ascending the shaft. Any brakeman having the sanction of the viewer to learn any other person to brake, to be answerable for any damage done by reason of the ignorance, carelessness, or want of skill on the part of any such learner; and should any accident happen by reason of the carelessness of the brakeman, or plugman in charge of the engine, by which any damage is done to the engine or otherwise, the amount of such damage to be paid by him, or to be deducted from his wages then due, or afterwards to become due. The brakemen are ordered to go at a slow rate when men or boys are descending or ascending the shafts.

82. The pumps and pumping apparatus are under the immediate charge of the engineer, whose duty it is to see that they are at all times kept in an efficient working state, and that the water is not allowed to accumulate, but regularly drawn as it comes to the engine.

83. It is the duty of the engineer to attend to the whole of the ropes on the colliery, and particularly the flat ropes, which he is to inspect daily, and to see that they are kept in a safe working condition. The banksmen who have a constant view of the flat ropes during coal work, are immediately on observing any flaw, to report the same to the engineer.

ABOVE-GROUND WORKMEN, ETC.

84. The day's work of the blacksmiths, wrights, joiners, masons, saddler, and others, is to consist of 12 hours, viz., from 6 o'clock in the morning until 6 o'clock in the evening, with the exception of the Saturdays and pay-Friday, on the former of which days they cease working at 4 o'clock, and on the latter at 5 o'clock in the afternoon. Half-an-hour allowed for breakfast, and one hour for dinner, on each day. The storekeeper to be the timekeeper. Any workman not being at his post when the bell rings for commencing work, or preparing to leave off before the bell rings at meal-times, or at the close of each day's work, is liable to be fined 6d.

85. The screenmen are, in screening and cleaning the coal, to free it from all stone, band, slate, splint, or foul coal, and also to free it effectually from all small, or in case they neglect to do so they are liable to be fined for every such neglect, a sum not exceeding 5s.

86. Every cartman and farm-laborer is to be at his place of working every morning at not later than 7 o'clock, and not to cease working sooner than 5 o'clock, one hour being allowed for dinner. Each man in charge of horses is to attend to them night and morning, and on the Sundays.

87. The day's work of the female laborers on the farms to consist of nine hours, viz., from 8 o'clock in the morning until 5 o'clock in the afternoon, (one hour being allowed for dinner,) and the day's work to be computed from the time each female commences, to the time she leaves off work.

88. Every workman is held responsible for the work tools and other property of the company intrusted to him, and they are particularly cautioned against appropriating any materials or time to their own use, or to any other than the purposes of the company, otherwise they will be liable to a fine, or to be taken before a magistrate for the offence.

89. No ale or other intoxicating drink is allowed, under any pretence whatever, to be consumed upon the colliery, (without the sanction of the viewer in cases of necessity,) and all persons are particularly cautioned against disobeying this order, on pain of being fined.

90. The rules relating to the management, treatment, and the responsibility of persons having charge of the under-ground horses, to apply to the above-ground horses, and the persons in charge of them.

91. Any workman above-ground leaving his employment before the expiration of a fortnight's notice to be given or received by him, shall forfeit all wages that may then be due to him, besides being liable to the laws now in force, for the regulation of masters and servants.

92. Any workman leaving his employment within six calendar months from the time that the owners may have been at the expense of removing his family or furniture to the colliery, is liable to pay the amount of such expense, which is to be deducted from his wages.

93. The storekeeper to be in attendance at the storehouse for the purpose of delivering any stores that may be required, every Tuesday and Friday, from half-past 8 to 10 o'clock in the morning, and from half-past 4 to 6 o'clock in the evening. No stores to be given out without an order from the viewer, the under-viewer, or the engineer, and none to be delivered without a printed order.

94. It is the duty of the engineer to see that the fire-engine and the necessary pipes are at all times kept in a proper working state, for which purpose he must try them once, at least, in every six weeks.

95. The under-viewer, overmen, engineer, or any other person in charge, are not allowed to absent themselves from the colliery on workings-days, without leave from the viewer.

96. No horses or ponies are allowed to be used except strictly for the purposes of the company; and the under-viewer, engineer, or others, are not allowed to take a horse from the colliery, without the sanction of the manager.

97. The truck system in any shape is strictly forbidden. It is expressly

ordered that no agent, or other person having any charge upon the colliery, is allowed to supply any workman, directly or indirectly, with any goods, or articles of trade of any description. The wages of the workmen to be paid in money, once a fortnight, at the colliery office, on the usual and accustomed day; and all persons in charge are cautioned against influencing any workman in the disposal of his wages, or in the purchasing of any articles he may require for himself or his family.

98. For the education of the children of the workmen, schools are provided—superintended by an efficient master and mistress. For the payment of 2d. per week, each scholar is taught to read and write, arithmetic, history, geography, &c., &c., and the girls are taught in addition sewing and needlework; they are also provided with slate, books, &c. The necessity of having their children educated is urged upon the workmen.

99. Any workman negligently or wilfully disobeying these orders and rules, or any other lawful orders of the viewer, or the head of the department in which he is employed, is liable to a fine of not more than 10s., or to be taken before a magistrate, at the option of the owners or viewer.

100. The overmen and the other heads of the different departments are ordered strictly to conform to these rules, whose duty it also is to see that they are attended to by the workmen, and every other person under their charge, (or report to the viewer any one acting to the contrary,) in order that proper steps may be taken to insure a regularity in the conducting of the works of the colliery, as well as with a view to the protection of the property of the owners, as to the safety of the lives of the people employed.

*** In the event of any of the orders, rules, and regulations herein set forth, not being attended to, such as not setting sufficient timber in, or insufficiently bratticing any working place, &c., &c., or in case any other neglect occurs, whereby the safety of the mine is in any way endangered, the workmen are particularly requested to make immediate complaint, so that measures may be taken for applying a remedy, and inflicting such penalties upon the parties offending as may be deemed necessary, or as the magistrates may order; and in order that the workmen may have at all times the fullest confidence in the safe condition of the colliery, they are at liberty to appoint a number of themselves, not exceeding six, nor less than three persons, to examine, at any convenient times, fully the workings of the colliery, and report the result of such examination as soon as possible.

All fines and penalties forfeited by a non-compliance with these rules, and which are to be deducted from the wages of the offending parties then due, or afterwards to become due, are to be kept in the hands of the clerk, (except in cases where one moiety is to be paid to the informer,) and appropriated as the owners or manager shall direct, as rewards for good behavior, or towards the funds of any institution established for the intellectual, moral, or physical improvement of the workmen, or towards the relief of such of them or their families as may be in needy circumstances, or towards the funds of some charitable institution.

By order,
MATTHEW B. ROBSON,
Viewer and Manager.

Castle Eden Colliery, December, 1847.

RECENT SHAFTINGS AND BORINGS THROUGH THE COAL STRATA OF THE SOUTHERN COAL-FIELD, NEAR POTTSVILLE, PENNSYLVANIA.

For some years past there has been amongst land-holders, coal operators, geologists, and others interested in the development of the coal region, a growing sense of the importance of exploring the deeper lying veins, which geology taught us to believe must exist near the bottom of all the coal basins. These explorations became the more imperative, as our mines near the surface were being exhausted. Of course the shafts or borings intended to develope the

lower coal strata were generally begun upon those estates where a point could be selected near the outcrop of the lower large white ash coals. As in other situations, these veins are not brought sufficiently near the surface by the anticlinal axes, or rolls of the strata, to make them particularly valuable for present operations. The first shaft was commenced by Alfred Lawton, Esq., in 1845, on the west side of Mill Creek, not far south of Mine Hill, upon the land of Henry C. Carey, Esq. Near this point the Mammoth White Ash vein is extensively worked above water level. This shaft was sunk 72 feet, then a boring commenced and penetrated to the depth of 122 feet, into the Primrose vein, after which it was abandoned and remained thus until 1852, when E. W. McGinnis, Esq., resolved to prosecute the exploration by sinking the shaft to the Primrose, and then boring to the Mammoth vein. The success of this enterprise was so decided, that it was immediately determined to continue the shaft (10 1-2 by 18 feet) down to the Mammoth vein. The following table exhibits the total thickness of various kinds of strata found during the process of boring, and indicates the depth from the surface at which some of the layers were found:

	Thickness.	Depth from Surface.
Rock and slate, ...	119 feet.	
Primrose Coal, ...	3 "	122 feet.
Rock and Slate, ...	68 "	
Holmes Coal, ...	4 " 6 in.	194 " 6 in.
Rock 64 feet, Slate 10 feet, .	74 "	
Coal, ...	1 "	296 " 6 in.
Slate, ...	51 "	
Coal, ...	1 " 8 in.	322 " 2 in.
Rock 54 feet, Slate 18 feet, .	72 "	
Coal, 7 feet vein, . . .	8 " 6 in.	402 " 8 in.
Slate, ...	14 "	
Mammoth White Ash, . . .	22 "	438 " 8 in.

But to preserve the order of time, we should observe that before continuing the enterprise of Mr. Lawton, Mr. McGinnis had prosecuted an extensive boring operation on the East Norwegian Creek, upon the lands of the Delaware Coal Company. This exploration begun in 1850, by a shaft which was sunk to the depth of 170 feet, when the search was continued by boring to a total depth of 656 feet. The following table shows the results obtained:

	Thickness.	Depth from Surface.
Slate and sandstone, . . .	42 feet.	
Coal and black dirt, . . .	18 "	
Rock and slate with iron ore, .	431 " 8½ in.	491 feet. 8½ in.
Black dirt, cut May 1st, 18 .	6 " 6 in.	498 " 2½ in.
Slate, 4 ft. 6, & rock, 4 ft. 6, .	25 "	523 " 2½ in.
Coal, ...	5 "	528 " 2½ in.
Rock and slate, ...	127 " 9 in.	656 "

This boring terminated in slate. Being located farther south from the outcrop of the Mammoth vein, than the first mentioned shaft, it was necessary to penetrate deeper in order to reach that vein. It is, however, likely that, at no very distant period, the Delaware Company will be justified in continuing this shaft to reach the large White Ash vein.

The third deep boring was undertaken by the North American Coal Company, who employed Mr. P. W. Shaeffer, late of the State Geological Survey, to direct the operation. After careful exploration of the surface, he located upon the Company's land in the valley of Crow Hollow, just below the celebrated Primrose vein. This boring was commenced in October, 1852, and finished in 1853. The following table shows the results:

	Thickness.	Depth from Surface.
Sandstone, slate and rock, . .	88 feet. 1 in.	
Holmes Coal, ...	4 " 2 in.	92 feet, 3 in.

Sandstone and slate, . . .	57	"	5½ in.	149	"	8½ in.
Dark brown slate, with iron ore and a seam of coal, . .	35	"		184	"	8½ in.
Slate with leader of coal, . .	10	"	2 in.	194	"	10½ in.
Rock and some slate, . . .	189	"	1½ in.	384	"	
Slate, ...	21	"		405	"	to the

Mammoth White Ash vein.

These are but the beginning of a series of enterprises for the development of our lower large coal seams, which must undoubtedly form the chief source of supply for future demands.—*Taylor on Coal.*

EXPLOSION AT THE MIDLOTHIAN COAL PITS—VIRGINIA.

A terrific explosion occurred at the Midlothian Coal Pits, in Chesterfield county, about thirteen miles south of this city, a few weeks since, by which thirty-four persons were instantly killed, and a number of others so badly burned that little or no hopes are entertained of their recovery. Up to the very moment of the accident, the superintendents and employees in the pits felt perfectly satisfied that there was not a particle of foul air afloat around them, and Mr. John Atkins, the agent, looked upon the pits as being so entirely free from danger, that he declared to us that he would not have hesitated to take his family into them to remain. Even now, the cause of the explosion is entirely hid in mystery, and must ever continue so, though Mr. Atkins inclines to the opinion that in making a blast, an old shaft sink was accidentally breached, from which poured forth a volume of gas, that became ignited, and swept as a besom of destruction through the various avenues, dealing death with an unsparing hand, on all that came within its course.

The explosion, when it took place, caused the earth, for miles around the pits, to wave and rock as a twig in the wind. One gentleman, who was crossing the railroad, about a mile from the pits at the time, said he felt the rails reel under him; and another, who was passing the road on horseback, declared that his beast staggered and trembled, as if suddenly shocked by a tremendous galvanic battery. The centre boards around the shafts were blown off, as if they had been paper, and at the western shaft, two large cable chains were broken in two as easily as if they had been pipe stems. At the time of the explosion there were three carpenters at work on the top of the eastern shaft, about thirty-five feet above the ground. One of them was so badly frightened that he leaped to the ground without incurring any injury, but "old Squire" and the other one held on to the beams until the shock was over, and then came down.

The Midlothian Pits have always been looked upon as free from danger, consequently the company found no difficulty in employing as many steady white miners as they desired; and if the explosion had taken place between the hours of 6 and 12 o'clock, we have no hesitation in saying that the loss of life would have been trebled, and the number of widows and orphans thereby created five times as great as that caused by the accident at the English Pits in May last; but fortunately, the men were not allowed to make over work, the supply of coal raised being greater than the demand, consequently, most of the white men had left the pits at 12 o'clock, and thereby saved their lives.

As soon as the explosion was heard, all the workmen above ground, from the Midlothian and English pits, hastened to the scene, and prepared to descend the Western shaft, to rescue those who might still be alive. Mr. Job Atkins, the agent for the English Pits, in company with a number of noble-hearted volunteers, descended the Eastern shaft as soon as they could do so, and the two parties immediately set about in search of such of the miners as they might find alive. They succeeded in rescuing sixteen persons, more or less burned, four whites and twelve blacks, and took them to their houses and the hospitals, where they were immediately placed under medical treatment. They then discovered about thirty dead men, some of whom they removed,

and others they were preparing to remove when we left the pits at half-past three o'clock yesterday afternoon. Mr. Atkins describes the scene as heart-rending in the extreme. Some of the dead men, the flesh charred on their bones, held their shovels in their hands, others were holding to their picks and drills; and Samuel Hunt, a small boy, who had been deprived of reason for the time, by the concussion, was calling loudly to the mule he had been driving to go along. Those who were not dead, as soon as they heard the voices of their friends, begged earnestly not to be left, and then prayed loudly for a few drops of cold water to quench their burning thirst.

In one of the avenues, several tons of stone and dirt had been thrown down, beneath which was discovered the bodies of two of Mr. Wooldridge's servants.

Out of fifty persons in the pits at the time of the accident, but three escaped serious injury, and these were colored persons, though there can be very little doubt that many of them were suffocated by the "after damp," rather than killed by the explosion.

Five valuable mules employed in the pits, which are 770 feet deep, were killed by the explosion.

STATEMENT OF TOLLS RECEIVED ON THE DEL. & HUD. CANAL AND RAILROAD IN EACH YEAR SINCE THE COMPLETION OF THE WORKS.

1830.	$16,422 44	Brought forward	$460,766 43
1831.	20,554 64	1843	30,996 53
1832.	28,717 51	1844	33,525 61
1833.	37,004 58	1845	25,880 92
1834.	36,946 07	1846	26,068 65
1835.	41,976 82	1847	38,971 34
1836.	45,154 73	1848	46,548 54
1837.	44,832 42	1849	34,817 95
1838.	40,328 38	1850	97,999 15
1839.	40,095 26	1851	158,441 96
1840.	35,450 46	1852	293,174 67
1841.	39,388 19	1853	378,479 83
1842.	33,894 93	1854	587,349 52
Carried forward	$460,766 43	Total	$2,213,621 10

NEW YORK COAL MARKET. April 8th.

New Castle, from Yard, for Gas, $7 50, 4 months—Hull, for steam, $7, 4 months—Pictou, from vessel, $6 25 cash per chaldron—Anthracite, $6 50 from vessels, and $7 cash per ton from Yard.

BOSTON COAL MARKET.

Lehigh Lump, $7–7.50, from vessels—Schuylkill, and Lackawana White Ash, $6 50–$7; Schuylkill Red Ash, $6 75–$7 25 from vessels; by retail $8 per ton.

New Castle retails at $13 for coarse; fine $10—Orrel $11 per chaldron.

IRON AND ZINC.

VIEILLE MONTAGNE ZINC MINING COMPANY.

This association, which has at various periods been noticed in our pages, in spite of all those difficulties which naturally arise in the formation of a large mining and manufacturing establishment, stands now in an enviable position among the most important commercial communities of Europe. As

doubtless many of our readers are aware, this company was formed for the purpose of working the ancient mines of calamine situate at Altenburg, Vieille Montagne, in Belgium, which is known to have been worked as long since as 1435, and, in all probability, at a much earlier period, since which, up to the present time, the mines have never ceased to produce large quantities of calamine, a carbonate of zinc, of a character almost free from impurities. It is well known that zinc in a metallic form was unknown to the ancients, although still large quantities of brass were produced by melting copper with calamine (*lapis calaminaris*); it was discovered early in the sixteenth century, as it is noticed by Paracelsus, who died in 1530, but does not appear to have been brought into use; probably from the difficulty of reduction.

In the year 1805 the Abbé Douy, while reducing calamine in the manufacture of brass, accidentally discovered a mode of condensing zinc from the ore, from which has arisen the present principle of manufacture known as the "Liege process of condensation." In 1808 zinc was known all over Europe, and its use was regarded as of some importance in the arts, from which it has risen to its present importance in a commercial point of view. In 1813 the concessions made to the Abbé Douy came into the hands of the Mosselman family, and from that moment great progress and improvements took place in the development of the mines; the construction of furnaces and melting and condensing pots; in the manufacture of metal, rolling into sheets, and other industrial operations; which have at length resulted in the present gigantic establishment, combining mining, smelting, rolling, and finishing the various articles of commercial value, to the extent of 20,000 tons per annum, being one-fourth of the entire produce from all the works of Europe together; combining operations giving employment to many thousands of workmen in Belgium, England, France, and America.

In 1837, the grant of these extensive estates, extending over 17,000 English acres, consisting of lands, forests, and mines, were converted by a royal decree into a *société anonyme*, under date 28th June. They are situate in the Belgian, Prussian, and neutral territories between the towns of Aix-la-Chapelle and Verviers. The metal, as assayed in London, is particularly pure, giving—Zinc, 0·995; iron, 0·004; traces of lead and sulphur, 0·001; probably the least contaminated zinc known. And from this circumstance alone might be presumed to have arisen the position the company holds in the commercial world, having established agencies in the principal metal markets of England, France, Belgium, and the United States, to which, however, must be added the unwearied and persevering exertions of the directors and officials, and the high and honorable influence of the names of its promoters and supporters. Not only has the company been a great producer of the metal in a merchantable state, but have been the means of its introduction and application to a large variety of useful purposes, for which this metal was previously unknown, and its importance unappreciated. The purposes to which this highly useful metal are now applied may be classed under the following heads:—cheap and solid zinc roofing for buildings; zinc sheathing for ships; zinc casts to imitate bronze; zinc oxides for paint; a substitute for lead, free from all injurious consequences to health; a large variety of articles for domestic, agricultural, architectural, and other useful and ornamental purposes; and in the Great Exhibition of 1851, in addition to the colossal statue of Her Majesty, 21 feet in height, were a very large number of highly interesting objects in this metal.

The company, in addition to their former extensive operations, are now prepared to undertake, through their manufacturing agents, contracts for the execution of roofs of all dimensions in the United Kingdom, or for exportation to the colonies. These contracts may, if required, include timber and iron framework, an arrangement which will give great facility to numerous descriptions of emigrants, and enable them to overcome many difficulties which must necessarily otherwise occur. The form of these roofs may be either plain or corrugated, and of various designs, while the lightness of the

material, and the flatness at which it may be laid, admits of a very considerable dimunition in the dimensions of the under framing, and consequently a large saving in its cost. The durability of the material produced by this company has been tested by long use on the Continent, the roofs of very large and well-constructed buildings being in good condition after standing 30 years' exposure, without repair, testimonials of which may be seen. It has also become a highly popular roofing for railway stations, and buildings of all kinds in this country, where its lightness, economy, and durability, and the ornamental forms in which it may be applied, strongly recommend it.

PATENTS.

For an *Improved Apparatus for Supplying Furnaces with pulverized Metal*; Eloy Schmitz, City of New York.

Claim.—"Arranging within the blast pipe of a furnace, or other fireplace, another and smaller pipe or tube governed by valves, to admit and cut off the blast, when this is combined with the charging tube, also governed by a valve, so that when the blast is forcing the pulverized substance from the tube within the blast pipe, the blast shall be cut off from the charging tube, and when the charging tube is open for the liberation of the charge, the blast shall be cut off by the valves below. Also, in combination with the above charging and discharging tubes governed by valves, the employment of a branch tube governed by a valve opening to the atmosphere, to prevent the pulverized substance from being held in the charging tube by any excess of pressure which may be due to the entering of the blast during the time the valves of the discharging tube are opened. Also, in combination with the discharging and charging tubes, the employment of the conductor and the punch rod."

For an *Improvement in Machines for Forging Horse Shoes*; Robert Griffiths, Alleghany City, and George Shield, Cincinnati, Ohio, Assignors to Robert Griffiths, Alleghany City, Pennsylvania.

Claim.—"1st, The arrangement of the sliding former and rising griper or their equivalents, operating so as to gripe the car both edgewise and flatwise at its mid length. 2d, The spring projecting plates or checks on the one side of the dies of the bending jaws, acting in connection with the face plate of the sliding shearing apparatus on their other side, for the purpose of preventing the metal from bending laterally whilst being turned around the former. 3d, The channelled bending jaws, for the purpose of confining the outer margin of the shoe during the process of grooving and punching, the side of the shoe being supported by the convex shoulders of the male former. 4th, The arrangement of the bending jaws and swaging die, for the purpose of imparting the desired relative width and thickness at every part, and of clamping it when thus formed, whilst it is grooved and punched by a separate die working around the swaging die. 5th, The retaining of the shoe in the gripe of the bending jaws by means of the cams which operate them having a portion of their periphery, the arc of the circle described from their centre of motion, or the equivalents of these devices, until the grooving and punching bits and male former are withdrawn, in order that the shoe may drop freely the moment it is released from said jaws."

For an *Improvement in Manufacturing Wire Rope*; J. A. Roebling, Trenton, N. J.

Claim—"I claim, 1st, Operating the top wagon by the same driving rope which operates the twisting machines, for the purpose of regulating the advance of the top in proportion to the twist. 2d, The propulsion and operation of the centre strand counter twist machine, by the same driving rope which actuates the main twist machine, for the purpose of insuring a perfect correspondence between the motion of the two machines, and at the same time to insure the proper tension of the centre strand by keeping it exposed to the

action of a freely suspended weight. 3d, The combination of the two sheaves with the hollow shaft for operating the endless rope, and to operate the main counter twist machine. 4th, The whole arrangement for operating the main counter twist machine, by means of an endless driving rope, which is kept under a great tension, by a suspended weight, and being at liberty to rise, allows the machine to advance as the strands shorten, and at the same time insures a constant and uniform tension. 5th, The peculiar arrangement for lowering the weight box, without slackening the driving rope, by the application of a break friction wheel and check wire, in connection with a windlass and spur gearing, or the mechanical equivalent therefor, and in combination with the sled and transfer sheave."

For an *Improvement in Furnaces for Making Iron Direct from the Ore;* Martin Bell, Sabbath Rest, and Edward B. Isett, Spring Forge, Tyrone City, Penn.

Claim.—"We claim the series of inclined close deoxidizing tubes or vessels, built of common fire-bricks, and arranged so as to be parallel or nearly so with each other, and inclined at an angle of about fifty degrees from the horizon, so as to lie or rest their whole length securely upon a substantial inclined base, and also so as to be exposed only on the two opposite outer sides of each tube, to the action of the escaping heat from the furnace as it passes along through the intermediate flues, the same being combined with the main flue through the opening, and with the interior of the furnace, each ore tube having an adjustable cut-off or sliding gate at its lower end, and also combined with a separate horizontal way, as described, leading directly into and connecting the said tubes with the bottom of the reverberatory furnace."

For an *Improved Rock Drill;* Edwin G. Dunham, Portland, Connecticut.

Claim.—"I claim, 1st, so arranging a horizontal plate on the drill rod, that by bringing the lifter in contact with it, in the manner described, it will be caused to incline slightly during the raisingof the drill bar, and consequently to bite or impinge upon said bar, and hold it firmly until it is raised to the position desired, and then, as the lifter escapes, again assume nearly a horizontal position, quit its hold, and fall with the drill. 2d, Rendering the friction plate for raising and dropping the drill bar, capable of removing said bar entirely out of the holes which are drilled, by employing, in connection with it, the friction plate, which is set inclined, and made to hold the bar as it is gradually raised. 3d, The plate, when set inclining sufficiently to hold the drill while it is being raised out of the holes that are drilled, whether it be used in connection with the friction plate or other arrangements in use for raising the drill bar. 4th, I claim increasing the friction of the plate upon the drill bar, and accelerating the descent and blow of the drill bar, by means of a spring arranged as described."

THE "IRON RIDGE" AND ORE BEDS OF DODGE COUNTY, WISCONSIN. CONDENSED FROM DR. OWEN'S GEOLOGICAL SURVEY OF WISCONSIN.

During the last three years, these deposits have attracted much notice, partly on account of the interesting and anomalous character of the ore, and partly because of the great practical value of a bed thus situated. "The Wisconsin Iron Company" has the credit of making the first experiment upon this ore; and, in fact, of erecting the first, and at present the only stack furnace in Wisconsin. The same enterprising gentlemen, who were the pioneers in iron manufacture in the State of Indiana, where they erected the "Mishawaukie Furnace," upon the bog ores near the Michigan line, have directed their skill, capital, and energy, to the same interest in the State of Wisconsin. Their works at Maysville, in Dodge County, are driven by water, and consume the ore of the "Iron Ridge," which is hauled on sleds in winter, about four and a half miles. The geological position of this ore has not been determined with precision. Mr. Lapham, of Milwaukie, has traced the formations to the eastward of the boundaries of Dr. Owen's survey of 1839, in places as far as Lake Michigan; but the fossils are so few, and so much of the surface of the

country mantled by deposits of drift, concealing the rocks, and the limestones possessing lithological or external characters so little marked and so little diverse at distant points, and their stratification so poorly defined, that it is very difficult to form a good opinion of the order of the strata.

According to Mr. Lapham, of Milwaukie, the lower sandstone formation extends into Dodge County, at the north-west corner and south-west corner; and the "lower magnesian limestone" is seen through the western part of the country resting upon this sandstone. Fig. 1.

In the south-west part of the country, the "blue limestone" is clearly developed. After passing an interval of four or five miles to the eastward of the latter formation, the "upper magnesian" or lead-bearing limestone is visible, having a breadth of about six miles; the eastern observed limit being six miles to the west of Rock River, on the south line of the country. These rocks all dip easterly.

Passing now over to the lake shore near Milwaukie, Mr. Lapham found the succession of rocks taken in the reverse order as follows:

1. Corniferous limestone.
2. Geodiferous lime-rock of Eaton.
3. Next beneath the geodiferous is a heavy bed of limestone, which Mr. Lapham calls, as a temporary name, the "Waukeshaw Limestone."

The Waukeshaw limestone, like the geodiferous and the corniferous, which overlie it, dips to the east. It appears in the south-east part of Dodge County, leaving an undetermined space between its western outcrop and the eastern presentation of the upper magnesian or lead-bearing lime-rock of about two townships or twelve miles. It is in this interval, but doubtless in the same formation, that the iron ore occurs. It appears in the face of a bluff, looking westward, and running nearly north and south, parallel with that portion of Rock River, between Horicon and Hustisville, and about four miles east of the river.

It exists on the surface in small *flattened oblong grains*, like flaxseed, but only about half as large, with a bright brownish red color, inclining in streaks to black or bluish black, with an unctuous, greasy, magnesian feel; soils the fingers and clothes badly, and gives a light blood-red tinge to water flowing through it when newly dug. Farther down in the mass, where it has not been disturbed by diluvial forces, it is darker in color, more compact, distinctly stratified, and occasionally stony.

Passing along the bluff to the southward, it inclines to the east, and shows red ochre for more than half a mile, in some places on the same level, at others higher up the hill, especially where it takes a more regular slope and the cliff is not seen. From the crest of the bluff, at the section, the level descends to the eastward, and ochre covers the lime-rock like soil or diluvium. To the northward, the same appearances are observed, and at about three quarters of a mile, where the Wisconsin Iron Company take out their ore, the hill appears to be all ore for sixty feet in height. The surface ore is here mined almost as readily as sand or loose earth, only stripping the soil and taking out the roots that are intermingled with it. The overlying limestone at Sterling's is a granular gray variegated whitish and yellowish limestone, that makes good lime. The analysis of the Sterling ore, by Professor J. L. Cassels, of Cleveland, Ohio, indicates over 58 per cent. of iron, which is as follows:

Peroxide of iron, . .	76·74	53·72 iron. 23·02 oxygen.
Sesquioxide of manganese, .	1·05	
Clay, . . .	4·00	
Silex, . . .	10·00	
Water, . . .	6·00	
Loss, . . .	2·21	
	100·00	

The Wisconsin Iron Company, under the management of John Niles, Esq., use the ore without burning, and find it to melt very easy without flux; in fact, it has been found necessary to introduce silex, in the shape of water-washed sand, to retard the process of melting, and thus improve the quality of the metal. In November, 1849, their charge consisted of fifty-five pounds of bog ore, sixty-six pounds of sand, thirty-five pounds of limestone, and six hundred and sixty pounds of the ochery ore unburnt. The yield with a moderately hot blast, was thirty-five to forty-two per cent. of iron; the furnace running out three and a half to four tons of metal per day, of twenty-four hours, with a consumption of one hundred and forty-five to one hundred and fifty-five bushels of charcoal per ton. The castings made from this iron are smooth, and the sound and texture of the metal was good, but seemed to be less tough than other castings. The manager was about to try the effect of cold blast on the quality of the iron.—*Dr. Turnbull.*

THE IRON TRADE OF GREAT BRITAIN.

During the past year there have been considerable fluctuations in the prices of manufactured iron, and the position and prospects of the iron trade have undergone a decided change. The year began with an advance of 20s. per ton, warranted by a previous advance on all the raw materials employed in the manufacture, and an immense influx of orders from all quarters, which considerably exceeded the capabilities of production. The advance was well responded to in America, and the trade continued in so prosperous a condition, and the demand so largely in excess of the make until about July, that in that month a further advance of 20s. per ton was declared. The makers were, so to say, compelled to take this step to keep pace with the ever-rising price of the raw material; but those adverse influences which then threatened the prosperity of the trade, and made the advance a decision of questionable policy, soon developed the gravity and the magnitude of their character. In America, the financial pressure, which, instead of passing away, as was hoped from month to month, soon took the nature of a commercial crisis, and caused a growing stagnation of trade. In this country, the war, with its prospective great demands upon the resources of the community, and its effect of diverting capital from the usual necessities of trade into other channels co-operated to cause a retrograde movement in the iron trade. In the United States the advance of last July was never responded to, and already in August and September, some of the inferior brands of iron, and particularly sheets and plates, receded in consequence; and although no alteration was declared at the October quarter, prices were not sustained, and the want of orders was seriously felt.

The year has closed gloomily. A vast amount of capital has been expended throughout the iron districts in putting up new furnaces and new works, with a view to adapt the powers of production to the great demand in the early part of last year; and now that most of these works have begun their operations, or are ready to do so, the demand has entirely passed away, and it is not even sufficient to keep the old works well employed. This refers particularly to those manufacturers who have principally depended for their sales upon the American market—those engaged in the home and continental trades being still moderately employed.

At the quarterly meetings of the iron makers, held last week, a reduction of £2 per ton was agreed upon, in the hope that this decline would call forth orders.

We subjoin a statement of the total exports of iron, &c., from this port to the United States and Canada; as also their distribution among the various ports of destination, for the years 1854 and 1853; also a table of Scotch manufactured iron from Glasgow to the United States and British North America, during 1854.

Comparative View of the Exports of manufactured Iron, &c., from Liverpool during the years 1853–4.

	1853. Tons.	1854. Tons.	Tons.
Exports from Liverpool to the United States,	301,675	232,420	Dec. 69,245
Exports from Liverpool to British N. America,	25,999	30,728	Inc. 4,729
Total exports, ...	327,674	263,148	

Thus showing a decrease of 59,255 tons in the exports to the United States, and an increase of 4,729 tons to British North America, during the year 1854, against 1853.

Exports from Liverpool to the United States, 1853–4.

Description.	New York. 1853. tons.	New York. 1854. tons.	Boston. 1853. tons.	Boston. 1854. tons.
Rods, bars and bolts, . . .	46,821	56,456	19,794	23,024
Hoops and bands, . . .	6,538	7,325	1,381	1,429
Sheets and plates, . . .	13,786	10,718	2,277	3,413
Rails, ...	61,786	23,500	130	1,583
Pig iron, ...	38,023	27,822	5,422	6,709
Tin and terne plates, . . .	22,632	17,235	1,370	2,359
Total, ...	189,635	143,056	30,374	38,517

Description.	Philadelphia. 1853. tons.	Philadelphia. 1854. tons.	Total to United States. 1853. tons.	Total to United States. 1854. tons.
Rods, bars and bolts, . . .	12,609	9,940	97,300	99,935
Hoops and bands, . . .	1,247	1,022	10,220	10,677
Sheets and plates, . . .	1,875	1,221	19,104	16,096
Rails, ...	....	279	86,497	34,652
Pig iron, ...	10,704	9,681	61,732	49,136
Tin and terne plates, . . .	1,029	519	26,793	21,924
Total, ...	27,464	22,662	301,675	292,420

Exports of Scotch Manufactured Iron from Glasgow to the United States during 1854.

	Tons.
Boston, ...	976
New York, ...	546
San Francisco, ...	77
Philadelphia, ...	57
Total, ...	1,656

Scotch pig iron, after ranging from 75s. to 85s. per ton during the first nine months of the year, receded about 15s. per ton in November, and closes to-day at 69s. 6d. per ton for No. 1 American brands, and 66s. 6d. per ton for mixed Nos. other good brands in Glasgow.

The stocks in Glasgow were estimated—

	Tons.
31st December, 1852, ...	450,000
31st December, 1853, ...	245,000
31st December, 1854, ...	130,000

Showing a decrease of 115,000 tons during the past year, or 320,000 tons during the past two years.

The exports of Scotch pig iron to the United States were during

		1853.	1854.
New York,	tons	84,378	60,186
Boston,		38,342	32,638
Philadelphia,		15,075	14,993
Baltimore,		2,631	2,382
Providence,		3,755	6,242
New Orleans,		9,807	4,844
San Francisco,		50	40
Sundry ports,		1,800	2,548
Total,		155,847	113,873

Showing a decrease of 41,974 tons during 1854, as compared with 1853.

There has been little fluctuation during the year in tin plates. The manufacture was not remunerative, and the make has been considerably decreased. In our first comparative table we have given the estimated weight of the exports of tin and terne plates during 1853–4. We here subjoin a statement, showing the total number of boxes exported to the United States and Canada during the period, with the increase and decrease to the ports specified.

		1853.	1854.	Dec.	Inc.
To New York,	boxes	439,949	349,583	90,366	.....
To Philadelphia,		26,715	11,019	15,696	.....
To New Orleans,		35,451	30,234	5,216	.....
To Balt. and Chs'ton,		2,553	3,777	....	1,224
To Boston,		31,192	47,267	....	16,075
To Canada,		17,280	30,460	....	13,180
Total boxes,		553,140	472,340	111,279	30,479

Showing a decrease in the year 1854, of 80,800 boxes compared with the preceding year.

Copper and yellow metal have been quite stationary during the whole of 1854.—*Circular of Naylor, Vickars & Co.*

QUARRIES AND CLAYS.

RESULTS OF SOME RECENT INVESTIGATIONS OF M. VICAT UPON THE DESTRUCTIVE ACTION WHICH SEA-WATER EXERTS ON THE SILICATES KNOWN IN THE ARTS AS HYDRAULIC MORTARS, CEMENTS, AND PUOZZOLANAS.

M. Vicat, to whom we are so much indebted for our knowledge of the preparation of cements, has recently presented to the French Academy of Sciences, the following *resume* of the chief general results to which a very long course of experiments upon that very important subject, the durability of cements in marine constructions, has led him:—

1. That the double hydrated silicates of lime and alumina, just mentioned, are very unstable compounds.

2. That pure water when poured upon all of them in the state of as fine powder as can be produced by ordinary means, no matter what might be their age or hardness, will dissolve a portion of their lime, provided they have not been in any way, or at least to a very slight degree, exposed to the action of carbonic acid.

3. That if, under the same circumstances, a very dilute solution of sulphate of magnesia or Epsom salt be substituted for the pure water, the greater part, and often the whole, of the lime existing as silicates, passes into the condition of sulphate. If any carbonic acid had previously acted upon it, the carbonate of lime thus formed is not decomposed by the sulphate of magnesia.

4. That all puozzolanas, no matter what may be their ages, require for their complete saturation, a very much smaller quantity of lime than is added in practice, especially when we take into account their very imperfect state of division from the rough way in which they are usually prepared.

5. That the affinity of carbonic acid for the lime in combination in these various silicates is so strong, that it is possible, with the aid of a little moisture, to completely neutralize it, wherever it can penetrate, and thus leave all the other constituents of the cement, whether in combination or not among themselves, as mere mixtures in the mass.

It follows, from these results, that sea water will destroy every cement, mortar, or puozzolana, if it can penetrate into the mass immersed in it. As, however, certain of these compounds are perfectly durable when constantly immersed in sea water, they cannot have been penetrated by it. Its penetration has been prevented by the surfaces, and the source of this inability to penetrate, is chiefly caused by a superficial coating of carbonate of lime, which has formed either anteriorly or posteriorly to their immersion, and which in time augments in thickness. The effect of a kind of cementation produced by the decomposition of the sulphate of magnesia, of the sea water, and the deposition of carbonate of magnesia in the superficial tissue of the mass, and the formation of incrustations and of submarine vegetation, contributes also to this impermeability. But all such superficial impermeable coatings, are not attached with the same force to the mass which they envelope. The differences which have been observed in this respect, depend in some cases upon the chemical constitution, and upon the peculiar cohesion of the silicates, and in others upon their submarine situation, relative to the action upon the waves and the rolling or dashing of shingle upon them. Hence the differences which have been observed by engineers in the durability of concretes of which such silicates form the gange.

M. Vicat is preparing a memoir, in which he will attempt to explain the nature of the chemical constitution of those silicates which are durable, compared with those which are not; and which will show the preponderating influence of silica in such phenomena. He will also point out a simple and certain method of classifying all such compounds, as to their fitness or not for submarine constructions, and thus will assist in very much shortening the time necessary at present for testing them by exposure to the action of sea water. From the great practical importance of the subject, and the attention at present directed to it, this memoir will be looked forward to with considerable interest.—*Comptes Rendus.*

MISCELLANIES.

MINING IN HUNGARY.

There are four mining districts in this country—viz., Selmetz-banya (Schemnitz), Szomolnok, Nagbanya, and Oravicza, and one in Transylvania, called Szalathna. The produce of gold in Hungary and Transylvania is about 6000 lbs. annually. The principal royal mines are Oberbieberstollen, Joseph II., Erbstollen, in the district of Schemnitz, Goldkunsshandlung, at Kremnitz, Koningsberger Goldgrube, in Rudain, the Anna and Teo Deo Copper Mines,

in Herrngrund and Altgebirge, and the antimony and gold mines in Liberthen and Magurka. The private mines pay dues to the Crown; gold, silver, mercury, and cobalt, 1-10th; copper and antimony, 1-17th; some of the inferior metals are free. All the mines are compelled to have their gold, silver, mercury, and cobalt, smelted by the officers of the Crown, and to sell them, if required, at a fair price. The other minerals can be smelted at their own establishments. The country produces but an inconsiderable quantity of coal. There is an opal mine at Cashau. The University of Schemnitz was founded by the Empress Maria Theresa, about the year 1760. The principal superintendent of the works receives 4,000 florins annually; the emolument of the several officers descends gradually to 800 florins; the surveyors, from 200 to 400 florins; and the laborers, from 40 to 200 florins, according to their ability. The principal tunnel to drain the mines, when complete, it is estimated will be 7850 fms. in length; somewhere about 6,000 fathoms are already driven; it was commenced in 1782. The uniform of the officers is dark green, strapped with silver braid, and the arschlieder is always worn. The popular tradition of the discovery of the mines at Schemnitz is, that during the reign of St. Stephen, a pig, grubbing about the forests, turned up a piece of pure gold. At Nagabanya, the mines are of great antiquity; coins of the Emperor Adrian have been found in the levels. At Verespatak, in Transylvania, they have left extensive workings. It is stated by mineralogists that the Romans understood how to extract gold from quartz when not visible to the naked eye.

NEW PUBLICATIONS.

Sheafer's New Map of Schuylkill Co., Penn. This is an elegant topographical map of Schuylkill County, Pennsylvania, the location of the principal anthracite coal mines, from which the American market is supplied. It shows all the railroads, canals, roads, and mining localities in the county, with complete statistics of their length, &c. It also presents the names of all the operators in the anthracite coal trade, shows the relative position of their locations, and the amount of coal mined in 1854. It is executed in a very fine style, handsomely colored, with the outcrop of the coal carefully defined. The well known reputation of the author is a guarantee of its accuracy. It is unquestionably the most complete map of the kind ever prepared in this country, and will serve admirably to convey an accurate idea of this important region to the immense numbers having interests there.

It can be obtained at the office of this Magazine, either in covers or on rollers, in any quantity.

THE

MINING MAGAZINE:

DEVOTED TO

Mines, Mining Operations, Metallurgy, &c. &c.

VOL. IV.—MAY & JUNE, 1855.—Nos. V. & VI.

Art. I.—SILVER, AND THE PRESENT STATE OF ITS WINNING.— No. 8.* By Alex. Trippel, Metallurgical Chemist.†

II. Amalgamation.

The amalgamation of silver ores differs very substantially from the amalgamation of auriferous minerals. In the latter, the process is a simple extraction of the small particles of metallic gold, and is founded on the great capacity of quicksilver, to form an alloy (amalgam) with gold, while, in the former case, that capacity is less powerful and the silver is very scarce in a metallic state, but found mostly as sulphuret, antimoniate and arseniate. It is therefore clear, that the amalgamation of silver ores is based on other principles than that of gold.

The first application of this process was made in Mexico and South America, and was invented, undoubtedly, after the discovery of America, as the Spaniards, when entering the country, could not hear any thing of it. It appears that the Mexican, Medina, living in the second part of the sixteenth century, was the inventor of the amalgamation, and that the first knowledge of it came to Europe about a hundred years after. Little regard was there paid to it, although Barba described the process very clearly, until *Von Born* in Hungary, and *Gellert* in Saxony, began to erect establishments in the year 1783; whereas, three hundred years before, forty-five establishments were in operation in Mexico.

The history of the theory of this metallurgical operation, offers an interesting example to show how a process could exist for several centuries and spread over another continent, and there be improved very substantially upon principles entirely wrong; so that the perfection of the practical manipulations was greatly in advance of the just knowledge of the theory. To-day we know that the whole operation depends merely on the triple condition,—that first, the silver in the ores is changed into a chloride, that the chloride is decomposed and reduced, and that the reduced metal is completely taken off by the mercury.

* Continued from page 172, vol. iv., March No.

The existence of the chloride of silver in the ores can be effected by means of the humid or by the dry way; the first named method forming a part of the American amalgamation, the last is adopted in the European process. For the better understanding of the chemical reactions above, in the American method up to that point, it will be necessary to set forth the reactions of the more important substances present, in the ores or additions, upon each other.

*1. *Deutochloride of copper and metallic silver.*—The copper, when dissolved in water or a solution of common salt, changes the silver into chloride and the deutochloride of copper into protochloride of copper.

2. *Deutochloride of copper and sulphide of silver.*—No reaction if water is employed. The copper, dissolved in a saturated solution of common salt, decomposes the sulphide of silver slowly, being itself reduced to protochloride.

3. *Deutochloride of copper and chloride of silver.*—No reaction.

4. *Deutochloride of copper and rich argentiferous sulphides.*—The solution of the deutochloride in common salt decomposes in a few days the brittle sulphuret of silver, the ruby silver and the gray argentiferous copper ore.

5. *Deutochloride of copper and mercury.*—Decomposes the mercury to calomel until it has lost one equivalent of chlorine and is reduced to protochloride.

6. *Protochloride of copper and sulphide of silver.*—Dissolved in a common salt solution, acts upon the sulphide of silver, producing chloride of silver and sulphide of copper.

7. *Sesquichloride of iron and sulphide of silver.*—Acts like deutochloride of copper, but slow.

8. *Chloride of iron and sulphide of silver.*—No reaction.

9. *Sulphate of copper and common salt.*—They produce deutochloride of copper and sulphate of soda.

10. *Mercury and sulphide of silver.*—The sulphide is *partly* decomposed, but with difficulty, forming sulphide of mercury and an amalgam of silver.

The fact, now, that deutochloride of copper acts so slow on sulphide of silver, if dissolved in water, and more energetically when a solution of common salt is employed, has caused the inquiry as to the manner in which the superfluous salt is acting, as in itself alone it shows no reaction whatever? Boussingault, for this purpose, has made a series of experiments, which showed that the existence of the deutochloride is only ephemeral, that in the moment of its action it is reduced to protochloride, insoluble in water, but soluble in a solution of common salt, where it forms a double salt with the chloride of sodium, and is decomposed in the pres-

* Karsten's Archiv. vol. xxv.

ence of silver sulphuret, in producing sulphide of copper and chloride of silver. The better part of the action of the deutochloride therefore does not show itself until it is decomposed and reduced to protochloride. If we look over the above-mentioned reactions we shall undoubtedly agree to adopt the following theory of the origin of the chloride of silver in the American amalgamation.

The common salt and the "magistral," consisting mostly of sulphate of copper, which are added to the ores, are decomposed into deutochloride of copper and sulphate of soda, leaving a part of common salt undecomposed, in solution. The first, in contact with argentiferous sulphides, is reduced to protochloride, while the free atom of chlorine changes an equivalent portion of sulphide of silver into chloride, and the free sulphur is partly precipitated and partly combined with a portion of copper forming a high sulphuret; the protochloride of copper, dissolved in the rest of chloride of sodium, finishes the action upon the sulphide of silver and produces chloride of silver and a single sulphuret of copper.

Opponents of this theory have remarked that the magistral, in some cases, contains no copper, but iron; this proves nothing, as we have seen that the action of this body is similar to that of copper, provided it is sulphate of peroxide and not protoxide, as the last has no effect at all.

We now see, by this, for what purpose the magistral is added, and why the common salt ought to be employed in a larger quantity, as, theoretically, it would be necessary to change the silver intó chloride. Even the fact that the chloride is somewhat soluble in a solution of common salt, and consequently more liable to come in contact with the mercury, speaks strongly in favor of the presence of superfluous salt.

The European amalgamation produces the chloride of silver in a very different way. The salt here, too, furnishes the chlorine, but this body does not decompose the ore by double elective attraction as there, but acts directly as a heated gas upon the more or less desulphurized ore, or combines with the sulphur to form chloride of sulphur, while another part combines with the metallic silver. For this purpose the ores are mixed with pyrites, if they are poor in sulphur, and calcined in roasting furnaces, where one part of sulphur escapes, another part produces sulphureous and sulphuric acid, which forms sulphates with the metallic oxydes, but escapes under an increased heat as anhydrous acid. If chloride of sodium (common salt) is present at this moment, one part of the acid will unite with the radical of the salt and liberate the chlorine, which acts as above mentioned. On this occasion another part of the acid is reduced to sulphurous acid, in giving one atom of oxygen to the sodium.

Besides these general reactions, there is a circumstance which ought not to be overlooked. The silver in the ores is, in most

cases, in a double combination; the sulphide is bound to arsenic or antimony, and is changed by the calcining process into arseniate and antimoniate of silver, on which no chlorine, but the hydrochloric acid, has some effect, because the hydrogen of this acid combines with the oxygen of the antimonious (arsenious) acid, forming water, and exposes now the antimony and the silver to the action of the free chlorine. Experience has shown that sufficient steam is in the furnace, without being introduced extra, to form a part of hydrochloric acid.

Although this mode of treatment is decidedly superior to the American method, still it has some disadvantages, which consist especially in the necessity of using, in the most cases, a considerable quantity of pyrites, for the sake of producing enough sulphuric acid, and also a surplus of common salt, as it appears to be quite essential to overflow, so to say, the charge with chlorine gas. Hitherto all the trials to remove those inconveniences have failed.

Whatever way the chloride of silver may have been produced, the next question is to reduce it and to bring it into a state fit to form an amalgam with the mercury. This process too is founded on a different basis in the American and European amalgamations.

It would be superfluous to speak of the rapid, direct action of mercury on metallic silver, especially as very little silver is in a metallic state present in the ores. On the other hand the relation of mercury to the oxide, chloride, sulphate and sulphide of silver, is more interesting for the amalgamation. The action on oxide is hardly to be seen, and much less so if the oxide is bound to silica; on the sulphide it acts a little more, if these two bodies are rubbed together, one part of the mercury taking sulphur, and the other part amalgamating the silver; even the chloride is not changed in common temperature, in contact with mercury; but as soon as the temperature rises and water is added, the latter will decompose the chloride, one part of the mercury will unite with the chlorine and form calomel, another part forms the amalgam. The mercury, therefore, is divided between the chlorine and the silver, and that part which produces calomel is an unavoidable loss, and amounts, for every part of silver, to 1.81 parts of mercury. The fact, however, that some sulphide of silver is directly decomposed, and the presence of metallic silver, as it is the case in the Valecillo mine, diminishes of course the expenditure of quicksilver, and renders the process far more profitable. The decomposition of the chloride of silver by mercury is the leading idea in the American amalgamation. This part of the process is carried out more advantageously in Saxony. There the chloride is not decomposed directly by mercury, but by iron, which, under favorable circumstances, is added to the charge. It is clear, that in this case no loss of mercury is necessary, and if any, it arises merely from mechanical causes, while the least mismanagement of the American way produces a considerable loss by chemical action, besides that

which is unavoidable. Yet more energetic is the action of mercury on sulphate of silver, and more so in contact with iron. We may ask, why then the European process is not managed so as to produce sulphate instead of chloride, avoiding by this way all the additions of common salt? The answer is as follows: Until a few years past the most distinguished metallurgists thought the difficulties in calcining a charge to the point, where all the silver is changed into sulphate, were insurmountable; and in fact this operation requires an almost unlimited degree of caution and experience; notwithstanding it is practised at present, not for the purpose of amalgamation, but to extract the sulphate of silver with hot water. This new process is the invention of Mr. Ziervogal, of which we will speak hereafter. There is another fact, excluding the sulphate from the amalgamation; for this purpose all the other metals ought to be in the charge as sulphates, which again would not protect the mercury from being attacked.

All the professional men of the present day agree in the opinion that the reduction and amalgamation of the chloride of silver is the work of electricity. It is impossible indeed to believe that a close contact between all the different particles is existing, and if so, the experiments show that a momentary contact is not sufficient for decomposition. The action of the galvanic element is easy to be seen if some chloride of silver is put in a copper vessel filled with water, and the copper is touched with a piece of iron, when the chloride is soon decomposed; the action is more lively if, instead of water, a solution of common salt is employed. The silver, as an electropositive body, goes to the electronegative mercury and the electronegative part, the chlorine goes to the iron. These electric discharges increase the temperature, which accelerates the operation, while the fluid acts as a conductor of the electric current.

Having explained the outlines of the theory of the amalgamation, as it is generally adopted, we pass on to the manipulations of this process.

I. American Amalgamation

Is practised in Mexico, Chili, Peru and Bolivia. The ores are the usual ones, varying very much in their yield of silver; the richer ores are mostly saved for smelting. They are classified by the "Quebrador," next pounded in a stamp-mill, and ground with water in "arrastras" (crushing mills) to a very fine pasty mass, which is put in a yard (patio), and heaped up in circular patches (montones), of which 20 to 40 are called a "torta."

These montones are, as soon as the pasty mass has a certain consistence, mixed with a kind of impure common salt called "saltierra," and trodden down by mules. The quantity of salt varies from 2 to 20 per cent. according to its purity and the richness

of the ore. In a day or two, the montones being kept in the same state of moisture, the "magistral," consisting mostly of roasted copper pyrites, is added to them in a proportion from ½ to 5 per cent.; if the ore itself is rich in pyrites the magistral is replaced by calcined ore. The incorporation of the magistral being made, the torta is trodden repeatedly by mules, when after a few days the first part of mercury is filtered through a bag of canvas on the whole surface of the heap, about three times the amount of estimated silver in the torta, which operation is followed by another treading by mules, and a turning by wooden shovels to restore the original form.

From this moment the torta is observed very carefully by the "azoguero" (amalgamators). A measure of the state of things in the torta gives the temperature, and more especially the appearance of the quicksilver. These signs depend on the respective quantities of magistral and salt in the torta; too much of the first raises the temperature too high, and, acting directly on the mercury, causes a considerable loss of this metal, which appears in this case with a dark color, much divided and with a tail; the remedy is an addition of lime, which decomposes the superfluous magistral; too little of it leaves the torta too cold, the mercury appears in its original state, while a just quantity of magistral produces a moderate temperature and shows the mercury with a faint white color, covered with some dust. In this last case it should get stiff in some time; if not, there is some probability that salt is wanting.

The "azoguero," in order to ascertain the state of the operation, takes samples every day to prove the appearance of the quicksilver, and it presents hardly a metallurgical operation, which absorbs so much the attention as that process. The "tentadura" (assay) is easy in the hands of a master, but the mastership requires long experience, a sharp look, and undisturbed observation.

The additions of smaller portions of mercury are continued from time to time, mostly three or four times, also the treading, until the ore appears to be desilverized, which requires about from two to five months, according to the weather, and the more or less skilful management. The last portion of mercury after this, has for its object, to make the amalgam more fluid and is called "el bano" (the bath). The whole amount of employed mercury varies from seven to ten times the amount of silver in the ore.

The mode of treatment for richer ores is somewhat modified. They are mixed with salt and some magistral, and put into copper boilers, filled with water, where they are amalgamated with the application of heat. Although this way is so imperfect, that the remainder has to be treated again in tortas, it was found that the loss of mercury was not so considerable and the result quick,

if properly managed. Another modification is carried out in Poullaouen, France, where the use of magistral and the montones are borrowed from the American, and the use of casks for the amalgamation from the European mode. The ores are mixed with 9 per ct. magistral, which is composed of about 60 per ct. salt, an d the rest is sulphate of iron, besides very little copper, and ought to be prepared at least one or two years before its use, to change the protoxide into peroxide, as the first is ineffectual. The wet charge is put in boxes, of which sixteen are in a row, and is moved from one to another until it has passed all sixteen, after which the charge is amalgamated in wooden tons.

II.—European Amalgamation.

The most perfect, and with the exception of the mode newly invented by Mr. Ziervogel, the most economical way for a European to benefit the silver of his ores, is undoubtedly by the European amalgamation, which is carried out especially in Saxony in an almost unsurpassable manner.

The ores are the more special silver ores, yielding from 1 to 20 oz., on the average in the charge 3 to 4 oz. per cwt. All the argentiferous lead, or copper ores, yielding more than 4 per ct. lead or 1 per ct. copper, and all auriferous silver ores, of which the gold cannot be easily extracted beforehand, are excluded from this process. The classification of the ores and the mixture of them in the charge, is a matter of importance in order not to use more extra pyrites than is indispensable for the decomposition of the salt; the sulphurets in the charge ought not to give less than 20, and not more than 50 per ct. of raw mat, if assayed for, while an examination of the nature of the ore and the additional pyrites will determine what amount within these limits will be the most judicious. In such cases, where no pyrites can be had, and the ores are too poor in it, some sulphate of iron is applied. The charge, as soon as prepared so far, is laid on a floor, carefully mixed with about 10 to 11 per ct. salt, sifted and divided in so called roast posts of 500 pounds each. The calcination now following is the most important of all the operations; it is usually done in reverberatory furnaces of 10 feet in length, 7 feet breadth, and 18 inches height from the hearth to the arch. The fire-room and flue are opposite each other, and the working doors on the long side of the furnace; in the arch are one or two openings to charge the furnace from the elevated charging floor. The heat is kept moderately dark red, until the salt has decrepitated and all the moisture is expelled, while at the same time the charge is constantly stirred with a rake, and the formed lumps carefully broken down by means of an iron beater. The charge then is again spread equally over the hearth, and the fire gradually increased, the stirring and moving

is continued until in two hours the charge becomes red hot, when the sulphur begins to burn, and the fire is left down. At this time the ore is more voluminous, and the particles cohere so little as to escape to the rake, but it becomes more compact with the combustion of the sulphur, and in two hours the charge appears dark. For the third time the fire is renewed, and the charge, which swells up again, stirred; and now greenish, corrosive vapors, consisting of chlore, hydrochloric acid, chloride of sulphur, and iron, make their appearance. In about three-fourths of an hour the operation is discontinued, and the charge taken from the hearth. The charge after the calcination, consists besides the earthy matters, of oxide of iron, basic sulphate of iron, chloride and sesqui-chloride of iron, oxide of copper, sulphate, proto and deuto-chloride of copper, sulphate of lead, sulphate of soda, chloride of sulphur, traces of sulphurets, antimony, and arsenic, and chloride of silver, originating almost exclusively from the third period of calcination.

The next work is the screening of the ore in a screen with only four holes per square inch, to separate lumps, after which it is sifted in sieves, with 20 to 25 holes per inch. The lumps are broken, and, together with the coarse from the sifting, roasted again, with an addition of some salt; the fine part is ground and bolted to a fine powder, in mills constructed similar to the usual flour mills.

The following amalgamation is now performed in wooden casks of from 16 to 23 solid feet in their contents, large enough for charges of 10 to 16 quintals, strengthened thoroughly with strong iron hoops, and provided with iron axles, a cog-wheel communicating with a shaft, and a wooden spout, with a second pin on its centre, in the bulge, to introduce the charge. The socket is movable for to arrete the cask. The charging and discharging is carried out by means of a hose reaching down from the ore, boxes placed on an elevated floor, a system of pipes for the water and mercury, and gutters underneath the casks, conducting the argentiferous quicksilver and the residue into appropriate vessels.

The operation is performed in the following manner at Halsbrücke. The casks are filled each with about 300 pounds of water, after which 1000 pounds of ore are added. The spouts are secured and the casks set in motion for about two hours, and with 14 to 16 revolutions per minute. The mass is now examined to see whether it is in a proper state of toughness to form a ball if squeezed; and water or ore is added, according to circumstances. Although no quicksilver has been applied, yet this first period is of some importance, because the water has dissolved part of the soluble salts and formed that lixivial fluid, which is so essential in the process. The next addition is 500 pounds of quicksilver, and about 70 to 110 pounds of square plates of wrought iron; the

spout is then secured, and the casks made to rotate with a rapidity of 20 to 22 revolutions per minute. At this time the temperature in the casks begins to rise in proportion to the warmth of the season, and the more iron there is in the charge. Generally the loss of mercury is reverse of the loss of silver in relation to the temperature, and the desilverizing is more perfect in summer. At the expiration of the next four hours, the pasty mass is again examined and the necessary additions made, and this examination is repeated after four hours more, when, however, only water, and no ore ought to be added. The operation is now continued for twelve hours, after which time the machinery is stopped, the casks are filled up with water, and set in slow rotation again for about two hours in order to collect the mercury, which is divided into numberless little drops. At last, the peg in the spout is taken out, and by means of proper tools the mercury is allowed to run off in a gutter from which it is conducted to a reservoir; the residue is afterwards removed through the large opening and led off to washing vats, where the last traces of quicksilver are separated.

The argentiferous mercury is now filtered, and pressed in canvas bags, and at some places through the pores of wood by means of an hydraulic press, where the amalgam, containing 84 per cent. mercury, 11 per cent. silver, and the rest, copper, lead, etc., is retained as a moderately solid mass, which at the present time is heated in iron retorts of 3 feet length, 16 inches breadth, and 12 inches height, provided with a tube for condensing the escaping vapors of quicksilver, and a door in the front similar to gas "retorts," for charging and discharging the mass.

The resulting silver has to be refined.*

The residue, after the mercury is washed out, is put in basins, and the solutions, when clear, are separated and concentrated in pans, after which they are placed in vats for crystallization. The resulting salt is impure glauber salt (sulphate of soda), and sold to glass manufacturers; the mother fluid, concentrated again, furnishes, if mixed with lime, a valuable fertilizer.

The losses of silver and mercury in this process are variable, and depend on the nature of the ore, the purity of the salt, and the skill of the management. Very frequently the loss of silver and mercury is in reverse relation, as for instance an addition of lime will save mercury but waste silver. The loss of silver arises mostly from volatilizing in the calcining process, and by mechanical ways; it amounts in Freyberg actually to 5 – 9 per cent.; the mercury is lost mostly as calomel in the residue, and, in the presence of much lead, arsenic, by the dispersion of it, and amounts at the same place to 3 1-2 oz. for every pound of silver produced.

* Will be hereafter described.

The amalgamation of argentiferous ores has decidedly many advantages in comparison with the smelting process. The operations are more simple, allow more oversight and a considerable saving of fuel, are more healthy for the workmen, and the results are quicker; in spite of these advantages the amalgamation cannot be recommended for leady ores; or when the fuel is cheap, while the salt and quicksilver are not easy to be obtained; even the yield in gold can determine in favor of smelting.

Hitherto we have followed the amalgamation of ores only, but we cannot leave this department, without mentioning the amalgamation of metallurgical products, and give the scheme of these processes, as far as they differ from those already described. At some places the ores are too poor to be amalgamated; they are smelted once, and the resulting raw mat is subjected to this operation. The mat, for this purpose, is ground and calcined so far that an assay in the crucible gives 15 to 18 per cent. second mat; it is subsequently mixed with 10 per cent. salt, and calcined like ore, after 2 per cent. lime has been added. The operation in the cask is different, as in this case the second period is shortened and the cask filled up sooner with water. The loss of mercury is a little more than before, and can only be reduced at the expense of silver.

Another process of this kind is performed at Mansfeld with copper mats, yielding 4 1-2 oz. in 100 pounds. The mat, after being pounded and ground as usual, is calcined, first with no additions, in furnaces with two hearths placed one above the other, in order to remove the superfluous sulphur. The sulphurets of silver, copper, and iron, are partly decomposed into metal, sulphurets, and oxides. The calcined mat is then mixed with 8 per cent. salt, and 12 per cent. lime, besides water, in which some salt is dissolved; by this the sulphurets are first decomposed in chlorides and—they having acted upon the silver—are destroyed again by the lime, which latter being changed into chloride of calcium, acts again upon the sulphates of soda, and forms sulphate of lime (plaster) and chloride of sodium. The next manipulation is a second calcination to support the chemical activity in the mass; it is performed in single furnaces, and a strong heat is applied, until samples of the charge show the absence of metallic sulphates. The amalgamation offers no peculiarities, and is like that of rawmat.

Argentiferous pig-copper, with a yield of 5 1-2 to 7 1-2 oz. silver, and 85 pounds copper in 100 pounds, is amalgamated at Schmöllnitz, in Hungary, and Ofenbanya in Transylvania. The pig-copper is pounded when red hot and sifted; the coarse from the sifting is made red hot again and pounded, and so on, until the whole is in a proper state for working. The powder is subsequently mixed with 7 to 9 per cent. salt, and calcined for about six hours in the usual way, after which it is screened and ground

like ore. The amalgamation itself differs in so far, as in the place of iron, copper balls are employed in the casks, and the water is used hot, and in the proportion of one solid foot to every 100 pounds of powder.

The residue is worked for copper.

The pig-copper from Ofenbanya requires a peculiar treatment in the calcining furnace, caused by a yield of about 10 per cent. of lead. Besides a more careful management, an addition of 3 per cent. saltpetre, 1 per cent. copperas (sulphate of iron), and 12 per cent. salt is made, to oxidize, as much as possible, the lead.

The amalgamation is as above, and the residue worked for copper.

The theory of the amalgamation of pig-copper varies somewhat from that of the ore and the mats. There we have seen it to be very essential, that the charge in the calciner was, so to speak, overflowed with an excess of chlorine gas, originating from the decomposition of salt by sulphuric acid, in order to desulphurize the sulphide and to form chloride of silver, and that, in consequence, a great part of pyrites had to be added.

Not so here. The silver is in the pig-copper not as sulphide, but in its metallic state, and the only question to answer is whether the salt has any action on the metallic silver so as to form chloride. Experiments now have shown* that salt, heated with silver and copper, forms chloride of silver, as well as deuto-chloride of copper, which latter is reduced to per-chloride, in giving one aeq. chlorine to the silver. The theory is therefore much more simple than that of the amalgamation of ores and mats.

The amalgamation of argentiferous pig-copper deserves the attention of all metallurgists, as it is far more economical than the liquation. The third part of this article, the "extraction," will show, however, that since the invention of Messrs. Augustin and Ziervogel, even this mode of treatment is surpassed by a new process, carried out in several places.

(To be continued.)

Art. II.—GENERAL REMARKS AND RULES ON THE WORKING AND WINNING OF COAL. No. 2.†—Translated for the Mining Magazine.‡

Rules which must be followed in the gallery working on the strata.—It is of great advantage to drive the galleries in a straight line

*Winkler, Amalgamat.

† Valuable practical portions of the entire work of which this article is a summary, have been translated and will be printed with the plates, from time to time, in the pages of this magazine.—Ed.

 Continued from page 158, vol. iv.

or in curves of a large radius; but with the bottom galleries these considerations are secondary, and it is a main requisition that they be invariably driven horizontally; for if they depart from the horizontal level, they possess either an ascent or a descent. In the first case the relative mining field is limited, and in the second the bottom waters no longer flow of themselves towards the shaft, and the hauling becomes unprofitable. A slight inclination towards the shaft is necessary. In working these horizontal as well as the galleries somewhat inclined one way, as is customary with the English miners, they make use of the water sewers, which accidentally occur in the strata; or if these fail, a few pails full from the sump of the shaft may be poured on the bottom of the gallery. This water will collect at the gallery slope on the inclining side, and form a little puddle, which will leave the miner no doubt as to the direction to be followed; for if he drives up the gallery so that the water runs off from the end of it, he attains the certainty of a slight ascent from the shaft.

Straight galleries answer the requisitions of mining the best and facilitate the operations. As regards the direction of the galleries in relation to the bearing of the strata, they are sometimes driven vertically on its layer clefts, in order to facilitate the winning, or they are conducted in a more or less diagonal direction, so as to attain for the galleries an angle of inclination suitable for hauling.

Galleries, the stopes of which consist of contiguous coal, preserve themselves very well; those driven through supported ground, must, on the contrary, receive in both stopes dry masonry of the best and strongest rock, thereby the galleries may long be kept open without additional security, unless it is a few posts. Finally, cross galleries with a larger "forste" at their crossing point, demand the most effective support. Brick masonry is the most practicable for galleries, that may long remain open, and which are driven through a brittle ground. Though its first construction is expensive, it costs nothing for preservation, and is, in this respect, much cheaper than timbering, which continually needs repairs.

Working system with long and short galleries and coal pillars.—The rules to be observed in this method may be comprised in the following particulars: The area of the pillars must be brought into the right proportion with that of the galleries, so that the "forste" shall not come down until the pillars have been raped. If the laying ground is brittle, while the strata and the hanging ground are firm, the pillars must, chiefly at the basis, be large enough not to crush into the bottom layers. Mild- and very clefted strata (as it is called) require strong pillars; they otherwise will be crushed by the pressure of the hanging ground, and coal blocks sever from it, so that their resistance becomes to that ex-

tent diminished, and their complete destruction follows and the hanging layers break down. If, finally, the hanging ground is brittle, the pillars must be large and the galleries narrow, but so driven that the stopes can be lined with rock, which may be taken from the strata or from the "country."

Wide galleries afford important advantages; their ventilation is easier, the coal mass less broken, gives more coarse coal, and the slits being further removed from each other, cause lower wages. These advantages fully balance the greater consumption of timber. If the winning galleries are put vertically upon the chief clefts, the working will be facilitated, and pillars obtained, which, with an equal area offer to the pressure of the hanging ground the greatest resistance.

The loss of coal by permitting the pillars to remain temporarily, is very considerable; the influence of the atmosphere changes the coal just as much as, though it was thrown in heaps upon the surface. The product of a strata ruptured by the effect of the hanging ground, has but small value, for even if the winning be conducted with every precaution, only small coal will be obtained, and that frequently mixed with clay slate. As the only means of avoiding these disadvantages consist in the immediate removal of the pillars, the prepared mining field must be very limited, or it must, according to the plan of the English mining engineer Buddle, be divided into independent fields.

Workings with rock support.—The height of the workings and the breadth of the galleries stand in proportion to the "country," i. e. the dead rock, which occurs in the strata itself or in the hanging or laying ground. At the working of thin strata or such as carry much gangue, the workings must be broad, while the number of galleries must be limited, and their section only be sufficient to meet the necessities of hauling and ventilation. On the contrary, strata of a certain magnitude, in which no slate clay or other mid-layers occur, whilst the galleries, driven in the same, have a sufficient height without affecting the hanging or laying ground, permit of narrow workings and very broad galleries.

Though the number of slits with the broad workings (ascending stoping) is proportionally less than with the narrow (pillar) workings, the first have the disadvantage, that the "slitting" causes much expense for labor, and that thereby a smaller percentage of coarse coal is won and much dust coal produced.

In England the rock obtained at the working is not generally sufficient for the support, whereas in Belgium and in northern France the rock won from the mid-layers and the side walls is seldom insufficient to the support of the works. In any case the miner obtains from the hanging and laying ground solid pieces of slate clay, wherewith to erect on both gallery stopes a dry masonry sufficiently strong, so that the timbering may be dispensed with, or greatly simplified. Broad galleries may therefore be

driven, which in regard to the hauling and ventilation are very advantageous. Unfortunately, rocks are often obtained in such quantities that notwithstanding the great height of the workings, the small sections and number of galleries, they cannot all be used. Such being the case, the support should be made very compact, and all old galleries and deserted workings be supported. The process can then be so arranged that several strata may be worked and won at the same time. The scarcity of gangue in one strata is compensated by its frequency in another, so that the rocks may all be disposed of. The miner has not, however, always such advantageous circumstances; he has not always such suitably composed strata to work. But even when they do occur, and the rocks have to be transported a great distance, it may occasion considerable expense, and they should then be brought to the surface.

When a place where coal has been extracted, remains unsupplied during a working shift, the pressure of the hanging ground and the expansion of the gases occasion a puffing up of the coal, whereby it peels itself off, producing a kind of natural winning. If the coal is hard, this effect may be facilitated by broad workings; but if, on the contrary, it is mild, much dust coal is produced by this influence, and every possible means should be employed to counteract the same. In the basin of Charleroi in Belgium these detrimental effects on very soft coals are frequently apparent.

If an irregular condition of the strata in a coal field may be anticipated, measures must be taken to avoid its effects, so that the winning does not decrease at the moment when a certain quantity is daily necessary to meet the demand of consumption. In the German and English coal districts these means of precaution consist in preceding the winning works by the chief or bottom gallery, in order to prepare the strata and to recognize the heaves and other irregularities. In Belgium, where the southern slopes of the strata very often show great irregularities, more workings are prepared in these cases than the demand of consumption makes necessary. If then some of them begin to fail, others supply the deficiency, until the dislocations, etc. are overcome, and the previous regularity of the strata regained with the necessary yield.

It is very important and necessary to make the support in the widenings behind the winnings works very compact; thereby not only will the sinking of the hanging layers be prevented, and the galleries remain longer open, but the loss of fresh air is also avoided, and a stronger ventilating current secured to the remotest workings. If combustible gases are developed from the strata, the support should be as near to the working slopes as the movements of the laborers permit; the narrowed current acquires a greater velocity, and therewith sufficient power to carry off with it the injurious gases.

Concentration of the workings.—At different points of a strata scattered workings require the maintenance of all the galleries, and occasion therefore much expense, particularly in ruptured and dislocated formations. Consequently it is an object to concentrate the workings on the most limited space; thereby not only diminishing the number of galleries, but the prepared field is also more rapidly wrought off, which shortens the time that the galleries and workings have to be kept open. The preservation of a gallery is the more difficult the older it is; and the saving gained in this manner, stands in reverse proportion to the time that the works are kept open. A concentrated work is more easily watched and better managed by the superintendent; there is less water to be disposed of than in widely scattered works, and the drainage is easier. The Englishman *Buddle* has his system, called panel work, and distinguished by narrow galleries and broad pillars, the winning of which, in single divisions, is effected backwards from the rear to the front, chiefly arranged for the sake of concentration. On the same principle it also happens that a mining field is rapidly wrought by limiting the height of the pillars, but proportionally accelerating the advance, or which amounts to the same, putting a stronger force to the stopes.

Limitation of the mining or working field.—Thereby is understood the surface of a coal formation, the strata of which is won or worked by means of a single mine. The numerous conditions which have an influence in favor of an extended or a limited coal-field, are the following: The greater or less difficulty of sinking shafts, whereon it depends, on account of the expense, whether only one shaft or several may be sunk; the depth of these shafts, which must descend to the coal-bed, in order to carry on from them the winning. The nature of the surrounding formation, if compact and solid, admits the working of galleries without all or any important timbering or masonry, as they may also be driven at great distances, without causing any material expense of maintenance, and may be made sufficiently wide to admit of hauling with horses; but if the rock is soft and brittle, their width and height must be limited to the smallest possible measure for hauling with men and wagons, and also their length on account of the expense of maintenance. These circumstances have such an influence that the extension of the coal-field, as to its bearing, does not exceed 250 or 300 fathoms, whilst under favorable circumstances the bearing length of the field amounts to 1,000 or 1,200, that is 500 or 600, and even more fathoms on both sides of the hoisting shaft.

The exploration of the strata, according to its inclination, by means of cross cuts, causes divisions, which are also called working fields; their length is necessarily conditioned by the above considerations, whilst their height is various, according to the working methods. The quantity of gas developed from the strata also comes into serious consideration, whether the strata have a slight

or a steep inclination; this development is the more important the more extended the stopes. But at the upper end of the same there is a point, above which the ventilating current becomes explosive and suffocating to human life. This circumstance must regulate the height of the coal-field, and it is therefore attended with danger to transgress the same.

Working of strata which lie near the surface.—The mining works occasion breaks of the hanging layers, which often extend to the surface and alter the form of the ground. Proper breaks, by which the upper layers break in blocks, are in general seldom to be feared, partially because the sinking of the layers suffices to fill up the empty spaces, and because the blocks form arches, which obviate the consequences of the breaks at a slight height above the point, where they originated. But it is otherwise with those formations, which in whole masses dip vertically or glide on upper layers like an inclined plane, and the breaks of which extend far over the won strata. Under such circumstances the progression of the mining works may be distinctly observed on the surface by its sinkings, as it is the case in many coal districts, for instance in the Couchant of Mons.

The working of strata, that lie near to the surface, must be conducted with great precaution and skill, as it is connected with several circumstances which can cause the entire destruction of certain mines, or at least materially decrease their future prosperity. For instance, if over a coal mining tract a river or canal passes, and the formation beneath their beds be cleft or penetrable by water, the water may easily force its way into the mining works and drown the same. In such cases strong coal pillars must be left standing for security. Only such safety pillars as in the strata *Katharina* of the *Victoria Mathias* mine, in the district of Essen-Werden, in Prussia, it was found necessary to leave, could prevent breaks, which would have been followed by a drought of the wells in the town of Essen, and a drowning of the mine. Similar alarms were the occasion of abandoning large masses of coal in the sunshine-strata of the mine *Kunstwerk* in the same district, since otherwise the waters of the river Ruhr would have broken in.

Whenever a coal-formation, water-carrying, or so-called floating layers occur, the works must by no means approach too near them, but strong safety pillars must likewise be left standing on the confines of both formations. By want of attention to these rules several mines in the Couchant of Mons were in danger of being overflowed or drowned, so that the Belgian government was obliged to pass a law, which requires that between both mining works and the laying part of the so-called dead ground (mort-terrain), which there consists of limestone layers, coal pillars of 50 meters height above water, shall be left standing, to prevent the breaking in of the water. In the Ruhr districts a Prussian law of

the 18th of June, 1846, prescribes that between the marl of the hanging ground of the coal-formation these pillars must have a height above water of 40.80 meters, or 20 fathoms.

When in the laying part of the "floating formation" clay or "fluccan" layers occur, no anxiety need be felt on account of such waterbreaks. Those soft layers give way at the ruptures without tearing apart. At Anzin, where such layers occur on the limits, one can approach with the works in their neighborhood without fear of danger, even when the upper surface of the ground sinks, and the houses are injured. On the locating of a mine, the strata of which do not lie deep beneath the surface, the mining engineer must assume the possibility of such injuries. He must therefore make an exact investigation of the magnitude and solidity of the immediate layers deposited in the hanging part of the coal-formation, then also of the productiveness and value of the ground above the works, which may be thereby injured, and whether springs and wells may be drained, so that at the end he will not have damages to pay, exceeding the profits afforded by the winning of the strata lying near the surface.

Working of strata from the laying to the hanging ground and reverse.—On the practicability of the working of different strata, laying one above the other, from below upwards, and from above downwards, much has been said. In the first case, the whole coal formation must then be sunk through with a shaft whereupon the lowest strata is first wrought, and then the others from the bottom upwards. There has much been said for and against both working systems, and, in the following, we mention the principal opinions advanced on this subject:

The advocates of the descending method of working are right in saying that, when the mid-layers, which exist between two strata, are not very thick and solid, the working of the laying strata causes the breaking-in of the hanging layers, and that these breaks could transmit themselves to the hanging strata, and result disastrously. In the worst case the working of the hanging strata would thereby be made quite impossible, and in any case it could only be accomplished with the help of a strong and expensive support, and very much small coal would be produced. When further, under other circumstances, a mighty strata is won, or a row of small strata, the workings of which have been imperfectly supplied with rock support, the sinkings are continued through all the hanging strata.

The descending working of several strata, i. e. from the uppermost to the undermost, has, as a necessary consequence, the successive removal of the pillars, which is commenced at the top. Where combustible gases are suddenly developed, they follow the laws of specific gravity, and gather in the "old man," where they are not injurious to the laborers. But if the reverse method is adopted, and the pillars are taken away from below upwards, the

gases escape from their places of confinement as soon as the atmospheric pressure is insufficient to keep them back, and the works above become then filled with them.

The advocates of this system further add: The expenses of establishing a shaft and its appurtenant parts are so great, and the time until it can be put to use, is so long, that, to avoid the use of too large a capital, it is important to accelerate, as much as possible, the time when productive operations take place, wherefore the coal is taken where it is first struck. The farther sinking of the shaft then goes on gradually, and, as it is necessary for the opening of the second, third, etc., strata or seam. If, for instance, the capital appropriated to the sinking of the shaft is totally exhausted, when a great depth had to be reached, operations are at once checked if an unforeseen accident occurs, or if the commercial aspects and the price of coal suffer an unfavorable change. Finally, there has also been made the observation, in Upper Silesia, as well as in Hainault, that the coal of the hanging strata, when the laying is first won, materially suffer, from exsiccation; in Upper Silesia it is called *dry coal.*

The advocates of the ascending method of working, on their part, offer other grounds, which, under certain local conditions, also have their weight. It is a means, they say, of learning the nature of a great part of the deep strata of a coal formation, for which a practicable working system may then be prepared. But to this their opponents reply that, in many coal basins, the process, with cross cuts, very advantageously substitutes the further sinking of a vertical shaft.

If, unfortunately, works in operation, and old ones, standing under water, get into communication with each other, the widenings in the laying strata form large receptacles for the straining water. Whilst they are filling, the miners have time to escape from the shaft, which would be impossible if the water had no deeper points to flow to, and should act in the mine like a current. As the dislocation of the hanging "country" cannot take place until after the winning of the last layers extending to the surface, the possibility of getting water into the mine is thereby much decreased. This material advantage is of some importance when it is possible to extend the winning at once to the last boundaries of the coal formation; it is, however, entirely illusory when, after all the strata, from the lowest to the uppermost, have been extracted, others remain under the mining field in question, which are yet to be won. Finally, in favor of this last opinion, an advantage is claimed in the successive decrease of the depth, out of which the drainage takes place, as the same ascends with the winning; but this assertion is without all ground, whilst the three preceding, in certain cases of exception, have something in their favor.

This discussion is a new proof of the errors to which absolu-

tism in the art of mining gives rise; for the arguments which are advanced by the defenders of the ascending system of mining, and which, for some localities, possess value, have for others no worth at all. In the Belgian province of Liege, in the circuit of Charleroi, and everywhere, where the upper strata are the object of old and drowned workings, it is sometimes practicable to carry the winning from beneath upwards, as thereby the miners and the works are protected. But even in this case it frequently happens that the mining field is laid at such a depth, that a safety pillar of sufficient capacity can be left remaining between the old and new workings, and that then the winning is carried from above downward. Thorough discussion therefore can only be of importance when due regard is paid to all local circumstances.

Art. III.—GEOLOGY OF WISCONSIN.—By James G. Percival.

The Mineral District in Wisconsin, so far as I have examined it, includes all that part of the State between the Mississippi, on the west, and the valley of Sugar river on the east, south of the line already indicated. Small quantities of lead ore are reported to have been found farther east, between Sugar and Rock Rivers, and even in the quarry at Janesville, on the east bank of Rock River. In general, the diggings are more frequent and more extensive towards the west, and become more detached and lighter towards the east, but with some important exceptions. These will be noticed, hereafter, more in detail.

STRATIFICATION.

The rocks in this district, form a series of strata, overlying each other nearly horizontally, already noticed in preceding reports. In describing them, I shall point out such characters and distinctions as I have myself observed, and which have appeared of practical importance. It has been noticed in other mining countries, that different rocks have different relations to particular minerals; that a given metallic vein, in one stratum, will yield more abundantly than in another, and will present peculiar characters in traversing each stratum. Such appears to be the case in this mineral district, and it hence becomes important to mark, as far as possible, all the different modifications in the strata.

The surface of the mineral district may be regarded in general as a plain, traversed in different directions by valleys and ravines, radiating from the principal water-courses. Seen from a distance, these are less obvious, the higher points of the surface, themselves on nearly a common level, commanding the view, and giving to

the whole the appearance of a vast plain. Above this plain rise a number of elevations, called mounds; some isolated, such as the Blue Mounds, the Platte Mounds, and the Sinsinawa Mound, in Wisconsin, and others forming connected chains of highlands, such as the range east of Galena, in Illinois, and the Highlands, along the west side of the Mississippi, in Iowa. These mounds are composed of strata, overlying the strata occupying the general plain.

The strata, in this district, appear nearly horizontal, but have slight dips in different directions. A general dip to the west of south has been recognized in former reports. A general dip to the south appears obvious, even if the part of the district examined by me be alone considered. Such a dip to the south would, in a general plane surface, bring the lower strata to that surface successively towards the north, and such, in the whole, appears to be the fact in this district. A general dip to the west has appeared to me less obvious, though favored by many facts, particularly the great extent of the mound rocks in the Highlands of Iowa, and the greater thickness of the upper strata generally towards the west.

Besides this general dip, local inequalities in the stratification may be observed at various points, indicating extraordinary elevations of the strata at those points. These appear to be rather detached elevations at different centres, than along extended lines of anticlinal axes. They occur generally in connection with the deeper valleys, where there has been a considerable degree of denudation, and at such points the lower strata are brought to the surface at extraordinary elevations, and exhibit striking inequalities within short distances. Such points of elevation may be observed on Fever (Galena) river, between Benton and Shullsburg; on the West Pecatonica, near Mineral Point; on the east Pecatonica, near Argyle; on the waters of Sugar River, near the line of Dane and Green counties, and on the Platte River, between Platteville and Potosi. From these centres of elevation the strata dip in different directions, by which the higher strata are found successively overlying the lower on the north as well as on the south. Thus the extraordinary dip to the north from the centre of elevation on Fever River presents the overlying strata on the surface to the north of the outcrop of the lower strata, and has given place for the occurrence of the mound strata at the Platte Mounds. In the same manner, there is at Dodgeville, though six to seven miles north of Mineral Point, a greater thickness of strata than at the latter, near which the lower magnesian is even brought to view. The details respecting these elevations will be given after the description of the different strata.

The series of strata, which I have had an opportunity of examining, may be thus arranged. 1. The Mound Strata, consisting of three distinct beds of limestone; the upper, middle and

lower. 2. A bed of Blue Shale, separating the mound strata from the next lower limestone series. 3. The Upper Magnesian of Owen, also consisting of three distinct beds. 4. The Blue Limestone, including the Blue and the Buff Limestones of Owen (1st Rep.,) also presenting three distinct beds. 5. The Upper Sandstone. 6. The Lower Magnesian of Owen. This last I have not yet had an opportunity of examining through its whole depth, but I have observed, in its upper portion, two distinct beds, well characterized. 7. The Lower Sandstone. This I have not yet had an opportunity of examining in connection. The arrangement of each of the limestone series, at least of the three upper, in three distinct beds, is worthy of attention. Other minor distinctions may be noticed, and have in different places attracted the attention of miners, as of practical importance. These I have endeavored to ascertain, and shall mention, so far as I have been able to determine them; but from their nature, they can be fully determined only by a more complete survey than I have yet made.

MOUND STRATA.

The Mound Strata, within the limits of the mineral district in Wisconsin, occupy only a few detatched points, considerably elevated above the general surface. These are: the Sinsinawa Mound, a detached summit near the south line of the State and on the limit of the towns of Hazel Green and Jamestown; the Platte Mounds, two detached summits, one east, the other west of Belmont, with a smaller elevation of the same character between them; the Blue Mounds, two summits forming part of a connected range, near the line of Dane and Iowa counties; and the northeast point of a range of mounds, extending from near Galena towards Shullsburg.

The three distinct beds, above mentioned, are most complete in the southern mounds, and are apparently partly denuded in the northern. They may all be distinguished in the Sinsinawa Mound, but the upper appears there less complete than in the Table Mound, an outlier of the Highlands, south-west of Dubuque. The entire series is composed chiefly of a thick-bedded limestone, fine-grained and nearly white, when unstained, and well adapted for building. The upper bed is characterized by a great abundance of corals, of which the *Catenipora** is the most distinctive. The middle bed abounds more or less in hornstone (flint), arranged conformably to the stratification. This, in the southern mounds, is less abundant, and more in detached nodules, while in the northern mounds, it is more abundant, and even in the Blue Mounds, almost replaces the limestone. In the northern mounds particularly, it is distinguished by a reddish-brown color.

* C. escharoides.

It may thus have given origin to the layer of red flint in clay, which immediately overlies the rock on the general surface throughout the mineral district. The lower bed contains little flint, and is less abundant in fossils, particularly corals, than the upper. It appears, however, thicker bedded, and is more important for lime and building. The mound limestone has never been found to contain any considerable deposit of lead ore. Traces of mineral are reported to have been found in it, and some fruitless excavations have been made, one of which I have examined on the top of the Sinsinawa Mound, but have observed there no appearance of lead ore.

BLUE SHALE.

The Blue Shale, wherever I have had an opportunity of observing, underlies the limestone of the mounds, and separates it from the Upper Magnesian limestone. It is composed of a thin even argillaceous slate, quite hard in its natural state, but more or less subject to decomposition into a soft clay, sometimes retaining its original blue color, but more usually stained yellow, and forming then what is called by the miners, a pipe clay. Its surface, from its tendency to decomposition, is always concealed by earth, unless exposed in ravines or by excavation. It extends to a greater or less distance around the mounds, and graduates by decomposition into the pipe clay, which overlies its undecomposed part, when thickest, and replaces it entirely on its outskirts. Thus at the Jamestown Mine, near the Sinsinawa Mound, it was found, in the engine shaft, immediately overlying the upper magnesian, unchanged, and itself overlaid by the pipe clay, while in shafts more remote from the mound, it was found entirely converted into the pipe clay. This bed is less open and pervious than the limestones, and consequently the water from the mounds issues in springs above it, marking the line of its upper surface.

The shale itself contains few, if any fossils, but at its junction with the upper magnesian, there is a very thin bed (two to three inches thick), composed almost entirely of very small fossils and concretions, usually firmly cemented by iron, and therefore called hard-pan by the miners, but sometimes softer and with a more calcareous cement. Usually one or more thinner layers (about one inch thick) of the same character are found interposed in the blue shale, within the first 2—4 feet above the upper magnesian. These fossiliferous and concretionary layers are important, as serving to determine the formation of the pipe clay, overlying the upper magnesian, from the blue shale. In the shafts, at the Jamestown Mine, where the pipe clay immediately overlies the upper magnesian, these layers are found precisely of the same character and in the same position, as where the unaltered blue shale meets the same rock. In different places on the higher

points, where the upper magnesian is most complete, that rock is found overlaid by pipe clay, in which the same fossiliferous and concretionary layers are found, in the same position as I have already stated. This I have observed very perfectly at the Muddy Diggings, on high ground, north of Cassville, at the distance of several miles from the mound rocks; the nearest position of these being in the Highlands of Iowa, beyond the Mississippi. In other places, the peculiar fossils and concretions of these layers are observed on the surface of the upper magnesian, where the pipe clay is less obvious. This I have noticed in different places on the higher grounds in Hazel Green, six miles from the Sinsinawa Mound, and still farther from any other locality of the mound strata. These facts seem to indicate a former general extension at least of the blue shale, over the surface of the upper magnesian.

UPPER MAGNESIAN.

The Upper Magnesian* consists of a series of limestone beds, of great thickness, in which the greater part of the lead ore, raised in the mineral district, has been found, and from that circumstance it has been sometimes called the mineral rock. But the other beds of limestone underlying it (the blue limestone and the lower magnesian), have been found to be good lead-bearing rocks, and consequently this latter term can no longer be regarded as distinctive. The prevailing character of the rock in this series, is that of a light gray thick-bedded limestone; sometimes uniformly fine-grained and even compact, but more often partly fine-grained and compact, and partly coarser grained and more distinctly crystalline, or even with small geodic cavities. This latter structure occurs more particularly in connection with mineral deposits, or in what is called the opening rock. In such instances, either the compact or the more crystalline portion may be the ground, through which the other is disseminated; the former as nodules or concretions; the latter as geodes, or approaching such.

The rock of this series is generally more or less subject to decomposition, and the coarser grained portions most so, which often gives to it a peculiar cavernous character. This circumstance renders it less valuable for building, although occasionally finegrained or compact beds occur of superior quality for that purpose. The quarry from which the Catholic Church at Benton has been erected is one of that character. This rock too, in the openings, is often found decomposed in part to a fine sand, retaining its

* This term, introduced by Owen in his first report, has been generally adopted in the mineral district, and for that reason I have preferred to retain it.

structure unchanged, in which the harder compact concretions lie loose in their original position, and are called tumbling rock by the miners. It has been called, from this circumstance, sandstone and sand-rock, by the miners, but as these names are liable to confound it with the proper silicious sandstone, they should be rejected.

There is generally a thin bed of a thinly schistose subargillaceous limestone at the upper surface of the upper magnesian, called shingle rock by some miners. Layers of shale occur occasionally through the whole extent of the series; sometimes distinct; sometimes firmly attached as a coating to the layers of the limestone. The original color of these is generally blue, but they are often stained green or yellow. They are usually found decomposed to clay in the openings, and are then called, in some places, clay randoms, and are regarded as useful guides in determining the position of the miner. In the lower bed of this rock, layers occur of a very thin black or dark brown shale, more or less bituminous, accompanying particularly the green and brown rock openings at Mineral Point, and between Benton and Shullsburg. Thin fossiliferous layers are also met with throughout the series, but most frequently in the lower part. The thicker bedded rock usually contains but very few fossils, and those of large size comparatively, while the thin fossiliferous layers abound in them, and those of small size and usually delicate texture. Some layers are found chiefly composed of minute fossils and concretions. The distinctive fossil of the entire series is the coral, called honeycomb or sun-flower (*Coscinopora*). I have observed it in all the beds of this series, but in none of the other limestones.

The upper bed of this series contains few or no flints, and is usually much thicker than either of the lower beds, and indeed, where it has suffered no denudation, is at least equal in thickness to the two lower combined. The middle bed abounds in flints, arranged in regular layers of nodules, usually white or light gray, but sometimes dark gray or black. The lower bed usually contains but few flints, but these are sometimes more abundant, particularly in the openings.

The character of the lower bed has not appeared as uniform as that of the two higher beds. Like the upper bed, it sometimes is light gray or bluish and compact, and is then valuable for building, when not too much jointed; but it is more often much traversed by argillaceous seams, separating or marking the surface of the layers. This bed is farther characterized by two peculiar rocks, known as the brown or black rock and the green rock, which occupy corresponding positions, but are usually found in different sections of the mineral district. On the Mississippi and Fever river, the brown rock is generally found connected with the openings in the lower bed, and contains more or less calcareous spar (*tiff*) disseminated through it. The green rock is found

in a similar position in the northern and north-eastern diggings. The original color of these rocks is bluish, but they have derived their present tint from the decomposition of iron pyrites disseminated through them. The brown rock is of a more or less deep red brown color, usually pervading it uniformly, and from its peculiar tint, was called the chocolate-brown rock by Locke (Owen's 1st Rep.) The green rock is usually less uniformly stained, sometimes only on its seams, and apparently derives its color from the green hydrate of iron. Thin layers often occur in this bed, composed chiefly of flattened fucoidal concretions, but rarely containing any fossils. Similar layers are occasionally found in the higher beds.

Bars of a hard blue limestone often traverse the upper magnesian, in its different portions, more usually in a horizontal position, like beds, but sometimes in a vertical position, like veins. They are more or less intersected by iron pyrites, and are apparently connected with mineral deposits, to which they have an important relation. They often interrupt the progress of mineral veins, and are then said, by the miners, to cut off the mineral; whence the opinion has prevailed that the blue limestone cuts off the mineral, an opinion erroneously transferred to the blue limestone of Owen, to which it has properly no reference. This subject will be farther discussed in connection with that of mineral deposits and veins.

BLUE LIMESTONE.

The Blue Limestone series includes the blue limestone and the buff limestone of Owen's first report. These both evidently belong to the same series; the first including the two upper beds, the second the lower bed, already indicated. The three beds, of which the series is composed, are of nearly equal thickness.

The upper bed is chiefly composed of thinner more fossiliferous layers, between which are interposed some thicker and less fossiliferous. Some of the layers are almost entirely composed of fossils, and in some instances are subject to decomposition, leaving the fossils loose and entire. Thin layers of bluish shale alternate with the layers of limestone, and are often found decomposed to a soft clay, usually stained yellow or green, particularly in the openings. The layers of limestone are marked by a peculiar parallel or laminated structure, distinct from that of the upper magnesian, and are partly light gray and compact, furnishing the best lime, and partly blue and more distinctly parallel in their structure, and apparently subargillaceous. Some of the latter kind have been found to furnish a good hydraulic cement. This bed is usually overlaid by a bed of brown rock, in thin layers, and breaking in small jointed fragments, with more or less cal-

calcareous spar disseminated, but with few or no fossils. It is interposed, in the northern districts, between the green rock and the blue limestone, and may be considered as the lowest member of the upper magnesian. In some instances, a bed of blue shale, decomposing into a soft clay in the openings, is interposed between the upper magnesian and the blue limestone.

The middle bed of the blue limestone is composed of more uniform and thicker bedded very even layers, less abundant in fossils, but presenting some which have not occurred to me in the upper bed, such as trilobites, and the acorn (*Streptelasma*). In the western districts, where most distinctly developed, this bed may be divided into three distinct portions: an upper, of a very fine crystalline grain, and of a light gray color, subject to a brown stain in connection with openings; a middle, of a dark gray color, hard and compact, breaking with a smooth conchoidal fracture, and called glass rock, in most of the diggings where it occurs; and a lower, forming a transition to the lower bed, and consisting of alternations of gray compact and bluish parallel seams, firmly connected, the former resembling the glass rock, the latter the prevailing rock of the lower bed. This lower portion is more fossiliferous than the two others, particularly on the surfaces of its layers. This distinction is well marked in Quinby's quarry on the Shullsburg Branch, north of New Diggings. In the most eastern districts, yet examined, this distinction appears less marked, nearly the whole bed being composed of a uniform fine-grained light gray rock, resembling the upper portion. The glass rock is there hardly represented. Nodules of flint occasionally but rarely are found in this middle bed, particularly in its upper fine-grained portion.

The lower bed, corresponding to the buff limestone of Owen, consists chiefly of a thick-bedded even rock, marked by a distinct parallel arrangement, and composed in a great measure of flattened vermiform and fucoidal concretions, most strongly marked on the surfaces of the layers. That these are merely concretions and not organic, appears to me very evident. The same structure is equally remarkable in certain thin subargillaceous layers, observed in the upper magnesian, particularly in its lower bed. The same appearance is observable in the transition from the sandstones to the lower magnesian, particularly on the surface of the layers, where marked by argillaceous seams. It would seem to be common wherever there is a combination of lime and alumine. This lower bed furnishes a brown lime, and in some portions of it, a good hydraulic cement, which alone indicates its subargillaceous character. The natural color of this bed is a light blue, but it is very much subject to stain, buff or yellow,* from

* It has been called, from this circumstance, the buff limestone, but might, with more propriety, be called the blue and buff limestone.

disseminated iron pyrites. Indeed in some districts, particularly the eastern, the whole series is generally found, at least near the surface, of a yellow color, only a few portions retaining their original blue color. The rock of this lower bed is easily dressed, particularly the middle portion of it, and in some instances is capable of a fine polish, forming, by its concretionary structure, a beautifully clouded marble. Quinby's quarry, above noticed, furnishes fine specimens. The same bed, in the quarry at Monerey (Janesville), has been used for that purpose, but its effect is injured by small geodic cavities. This lower bed contains comparatively few fossils, particularly in its middle portion. Trilobites have been found in it, as well as in the middle bed. At its junction with the upper sandstone, there is usually a transition from one rock to the other; a number of subsilicious and subargillaceous layers intervening, the former of which are more or less oolitic in their structure.

UPPER SANDSTONE.

The Upper Sandstone forms a bed of a generally uniform character, and of no great thickness, composed usually of fine grains of quartzose sand, very slightly cemented, and consequently very little coherent, often in the interior in the state of loose sand. The surface is generally more or less indurated, but often this harder coat is of very little thickness. The natural color of this rock is white, but it is very subject to stain yellow, red, and sometimes green, from the decomposition of disseminated iron pyrites. These stains are most remarkable on the surface and near the seams, and particularly near the junction of the rock with the adjoining limestones. At the junction of this rock with the blue limestone above, it is usually coarser grained, and often contains concretions of quartz, sometimes geodic, which have been evidently formed by chemical action. In this position too, concretions of iron pyrites, or of hematite resulting from its decomposition, are frequent; the latter often including a portion of the pyrites unchanged. Small nodules or seams of hematite, sometimes with iron pyrites, occur also in this part, filled with grains of quartz of a hyalitic appearance. This layer, which has been apparently so subject to chemical action, is usually of a dark red brown, or of a deep green color (the latter from the green hydrate of iron), and occasionally the adjoining sandstone, to a considerable depth beneath, is more or less stained green from the same cause. This rock is usually too incoherent to answer well for building, although generally sufficiently fine grained and thick-bedded for that purpose. It furnishes, however, a superior sand for mortar, and sometimes so hardens by exposure, as to be useful for building. In some districts, particularly on some of the eastern branches of the East Pecatonica, near the line of

Green and Lafayette counties, this rock is composed of thin nearly schistose layers, and its lower part is then more or less filled with minute white calcareous grains, giving it a firmer texture.

LOWER MAGNESIAN.

This rock I have not yet examined through its entire depth, having had an opportunity of viewing it only in its southern and eastern outcrops, on the Platte, Blue, Pecatonica and Sugar Rivers, and in a ridge 2—3 miles S. W. of Madison. The greatest depth to which I have yet seen it exposed, is nearly 100 feet, on the Big Platte, in Ellenborough. A thickness of more than 200 feet has been given it, on the Mississippi, by Owen, in his reports.* Wherever I have seen it, this rock has presented peculiar external characters, by which it can be readily distinguished from the preceding limestones. Among the distinctive marks which I have observed, the most striking are a peculiar concretionary nodular structure, and the occurrence of geodes lined with minute crystals of quartz, and of layers of flint less interrupted and nodular than in the preceding limestones, either white and abounding in geodes of quartz, or striped red-brown and yellow, resembling a striped jasper, and then more rarely geodic. Fossils are very rare, nor have I yet observed them in this formation.

Where I have had an opportunity of observing it continuously underlying the upper sandstone, on the Blue and Platte Rivers, it has presented two distinct beds, an upper and a lower. The first is composed of a series of alternations of subargillaceous and subsilicious limestones, more or less decomposable, with occasional interposed layers or beds of a purer and harder limestone. The subargillaceous layers sometimes form a marly shale, decomposing into a soft clay, and the subsilicious layers have often a remarkable concretionary structure, and resemble, in their grain at least, the silicious limestone of Fontainebleau. Sometimes layers of nearly pure sandstone occur even in the lower part of this bed. Flints, such as I have described, occur in this bed, particularly in the purer limestone, and in connection with openings; but they have appeared less abundant in this bed than in the lower. From the decomposable character of the greater part of this bed, its surface is generally covered with earth, forming a sloping declivity. The lower bed is composed of a hard and purer thick-bedded gray limestone, resembling in its external appearance the corresponding middle bed of the upper magnesian, but distinguished by its structure, and its peculiar flints already noticed. This lower bed has been seen by me only in its upper portion. It appears, both on the Blue and Platte rivers, only as

* Two hundred and twenty-five feet. (Report 1852.)

a low bluff (10—20 feet high) sinking below the surface. From its character, and particularly the great abundance of flints, it is apparently the middle bed of the entire series; a lower bed underlying it, corresponding in some degree to the upper bed already described. This, however, I offer only as a conjecture.

LOWER SANDSTONE.

This formation I have not yet had an opportunity of observing in immediate connection with the overlying stratum (the Lower Magnesian). The sandstone in the quarries west of Madison from which that town is supplied with its material for building, is quite different in its character from the upper sandstone, and apparently less purely silicious, and consequently less incoherent in its texture. It is overlaid in the quarries, particularly in those of the south (Larkin's), by subcalcareous and subargillaceous layers resembling not a little those which occur at the junction of the upper sandstone and the lower magnesian. Concretions of a flinty quartz are found in some of these, resembling similar concretions in the latter situation. From these circumstances, I should rather regard the sandstone in those quarries as belonging to the Lower Sandstone. This is farther rendered probable by the occurrence of those quarries on the north of a ridge, extending along the south side of Dead Lake, occupied by the lower magnesian, while the country to the south of that ridge is occupied by the blue limestone and the underlying upper sandstone.

It is worthy of remark that each of the limestone series admit of a three-fold division, distinct in the three upper series, and at least probable in the lower magnesian. A general character, independent of its fossils, pervades the whole of each series, by which it may be distinguished from the others, while each subdivision or distinct bed has its own distinctive characters. The middle bed in each is distinguished by an abundance of flint or hornstone, arranged in layers conformable to the stratification either in detached nodules, or more connected. This is less obvious in the middle bed of the blue limestone; still nodules of flint are there of occasional occurrence, particularly in the upper fine grained portion.

Estimates of the thickness of the different strata have been given in former reports; but such can be considered only as approximative, the strata apparently varying considerably in thickness in different localities. It may be considered a moderate estimate to reckon the thickness of the Upper Magnesian at 240 feet (120 feet for the upper, and 60 feet for each of the lower beds); that of the Blue Limestone and Upper Sandstone each at 60 feet; and that of the Lower Magnesian at 220 feet.

EXTENT OF THE STRATA ON THE SURFACE.

The extent of the mound strata has already been indicated. The mound limestone is immediately confined to the mounds themselves. The underlying blue shale extends to but a limited distance around the mounds, although traces of the pipe clay, formed from its decomposition, have been found in different places very remote from them, as already stated. The upper magnesian occupies the remaining surface of the mineral district, so far as I have examined it, from the Mississippi to the valley of Sugar River, except at the points of extraordinary elevation already indicated. Viewing the surface of the mineral district as a general level, the upper magnesian has been subject to denudation by the general rise of the strata towards the north, and by the extraordinary elevations above referred to. The valleys and ravines have farther caused a removal of the upper strata, and an exposure of the lower, and this to a greater degree towards the north, and at the points of extraordinary elevation. The rock occupying the surface is thus subject to frequent variation, and can only be determined exactly by long continued observation. I can only, at present, make some more general statements, leaving the particular determination to a farther opportunity. This is, however, a question of no little practical importance in mining. By determining precisely the stratum occupying the surface at any given point, the miner will know what depth of mineral-bearing rock he may there expect; how many openings, and of what character he may reasonably expect to meet. Where the whole thickness of the upper magnesian is known to be present, and this can be very satisfactorily determined by the occurrence of a bed of pipe clay with the accompanying fossil layers at its junction with the upper magnesian, and hardly less so by an abundance of the fossils of those layers lying loose on the surface of that rock, the extent of mining ground, other things equal, is of course greatest, and this will be diminished in proportion to the number of beds which are found to be denuded. Still where a great amount of the upper beds has been removed, particular localities, from the great richness of the deposits in the strata remaining, have been among the most productive of the district. Mineral Point is a remarkable instance of this, where most of the mining has been in the lower part of the upper magnesian, and in the blue limestone.

The effects resulting from the general rise to the north, are so much involved with those caused from extraordinary elevations, that the subject will be best presented by first detailing the latter. The first of these elevations, which I shall notice, is that along Fever (Galena) River. The point of greatest elevation is on that river, about three miles north of Benton, and about E. S. E. of Buzzard's Roost (Meeker's Grove), where the upper sandstone rises about twenty feet above the surface of the river. In the ra-

vine, descending north from Mecker's Grove to that river, the blue limestone is elevated at least thirty feet above the bottom of the ravine, on its east side, while immediately on the west side of the ravine, the brown rock (lower bed of the upper magnesian) sinks below the bottom, the strata on both sides remaining nearly horizontal; thus indicating a fault at that point. Proceeding north from that point, the lower strata soon disappear, and the different beds of the upper magnesian successively occupy the surface; first, the lower bed (brown rock); then the middle flint bed (at Elk Grove village and the Strawberry Diggings); then the upper bed (at the North Elk Grove Diggings), and this continues to the base of the Platte Mounds, where it is overlaid by the blue shale and the mound limestone. Proceeding south from the point of greatest elevation, the sandstone soon disappears, but the blue limestone is exposed generally in the bluffs of Fever River, to a point about two miles south of New Diggings. It does not, however, sink uniformly towards the south, but presents a series of undulations, rising and falling, and that sometimes quite abruptly; but no other instance clearly indicating a fault has yet occurred to me. The blue limestone sometimes appears more elevated on one side of the valley than on the opposite side, but this may have been the result of undulation merely. It also appears along the branches of the river to a greater or less distance from their junction, particularly along the Shullsburg branch, where the same undulations occur as on Fever River. The bluestone, in its progress south, apparently sinks below the level of Fever River, but again rises, at least twenty feet above its level, at Buncomb, and farther south, alternately sinks below and rises a few feet above the river, to its last appearance near the Galena and Chicago road. There would seem, in this instance, to have been an extraordinary elevation at the point near Meeker's Grove, above mentioned, causing a fault, with a gradual subsidence to the south, modified however by local elevations in its progress. This elevation would seem to have acted along the valley of Fever River, as an axis, throwing up the strata on each side. Thus the higher grounds, for about three miles south of Meeker's Grove, immediately adjoining Fever River on the west, and in the point between that river and the Shullsburg branch, are chiefly occupied by the lower bed of the upper magnesian, and the diggings are there mostly in that bed. Farther south, the higher beds of that rock approach the river, but the diggings there, near the river, are in the flint or lower bed, chiefly in the former, and those in the upper bed only occur in the highest grounds, more remote from the river.

The next point of extraordinary elevation is that along the West Pecatonica, near Mineral Point. The highest point of elevation is apparently in the fork of the Pecatonica and Peddler's Creek, north of the Mineral Point and Platteville road. The lower

magnesian there rises above the level of the river, presenting low bluffs (10—12 feet high) along its banks. Its exact junction with the upper sandstone is there concealed; a considerable interval, corresponding to its upper portion, intervening. From that point the strata sink to the north, as well as to the south. The sandstone, towards the south, sinks to the level of the Pecatonica, not far south of Bonner's branch. The bluffs of the same rock obviously decline towards the north, but I have not traced them far in that direction. There are, in this district, the same appearances of sudden local elevation as in the preceding. Thus on the east side of the Pecatonica, opposite Bonner's branch, the sandstone rises but a few feet (5—6) above the river bottoms, while not more than two miles farther north, it occupies two thirds of the height of a bluff, about sixty feet high, overlaid by the blue limestone. At Mineral Point village, the blue limestone rises high on the sides of the ridges, leaving only a moderate thickness of the flint bed at their summits, while the mineral openings are principally at the lower bed of the upper magnesian, and in the blue limestone. At the Dreadnought Mine, three miles north of the village, the main body of the flint bed is present, with its peculiar openings, and at Dodgeville, nearly eight miles north, a considerable portion of the upper bed of the upper magnesian is also present. At the Heathcock Mine (Linden,) six miles N. W. of Mineral Point, the blue limestone rises but a few feet (8—10) above the level of Peddler's Creek adjoining. These facts indicate a dip of the strata from the highest point of elevation towards the north. A similar dip is observable to the west, towards the Platte Mounds, and to the east, towards the high prairie ridge, separating the east and west branches of the Pecatonica.

Another point of elevation occurs on the East Pecatonica, at or near Argyle. At that point, there is an extensive basin, in which rise several low ridges, either composed entirely of sandstone, or of sandstone capped with the blue limestone. Different branches of the river here meet, from the north and the east, and along them lines of elevation may be traced, for several miles, in bluffs of sandstone, gradually sinking from the centre, but subject to local elevations, as in the preceding districts. This centre of elevation is bounded on the north by the high ridge extending west from the Blue Mounds, on the east by a range of high prairies extending southeast from the Blue Mounds towards Monroe, and on the west by the ridge separating the east and west branches of the Pecatonica.

Returning towards the west, another point of elevation occurs on the waters of the Platte, the centre of which is apparently on the Big Platte at Bald Bluff in Ellenborough, where the lower magnesian rises nearly a hundred feet above the level of the river. The exact line of junction with the sandstone is there concealed by the earthy slope covering the upper bed of the lower magne-

sian. The next lower bed of that rock rises in a low bluff from the water's edge. In tracing down the Big Platte, the lower magnesian appears to rise about 30 feet above the river level at the Red Dog bluff, and not more than 10 to 12 feet at the ferry on the Galena and Potosi road. At the latter point the sandstone forms a low ridge in the valley of the Platte, on the west. This is below the junction of the Big and Little Platte Rivers, and in this vicinity the different strata appear at a higher elevation on the west than on the east side of the river, the upper surface of the blue limestone on the east, appearing but little higher than that of the sandstone on the west. This point of elevation is connected with that on the Mississippi, by which the sandstone is raised above the water level from Sinipee to some distance above Potosi, and the blue limestone, towards the south to a point, on the east side, near Gregoire's Ferry (opposite Dubuque), but on the west side, only to Eagle Point (above Dubuque); the strata being there apparently most elevated on the east side of the river. On the north, I have not had an opportunity of tracing the limits of this centre of elevation. On the east it extends to the vicinity of Plattville, and is limited by the country adjoining the Platte Mounds, and on the south, it is confined by the high prairie between the Mississippi and Fever River, near the centre of which rises the Sinsinawa Mound.

Another centre of elevation apparently occurs on Grant River, south-east of Beetown, near the junction of Pigeon creek. At that point the sandstone is elevated 30 or 40 feet above the river, while lower down on the same river, at Waterloo, it is not exposed. The same is true on Rattlesnake creek, towards the west, and on the Beetown branch, towards the north-west, only the blue limestone appearing there at the surface. On Boyce's creek, south-east, towards Potosi, the blue limestone appears more elevated than in the vicinity of Potosi, as if within the limits of this centre of elevation. These limits are apparently the ridge of Boyce's prairie on the east, the high ridge between Grant River and Cassville on the south-west, and Blake's prairie on the north-west.

The excavations in the mines, in the vicinity of these extraordinary outcrops of the lower strata, are a farther proof of sudden elevations of the strata; the shafts being often sunk in the upper strata to a greater depth than would be sufficient to reach the lower, if the range of the latter from their outcrop was horizontal.

From the details of the above arrangement, some idea may be formed of the manner in which the different strata occupy the surface in the mineral district. On the higher portion of the ridges and prairies bounding the centres of elevation, the upper bed of the upper magnesian occupies the surface; most so towards the south, conformably with the general dip to the south.

On some of the higher points, even remains of the pipe clay, with its fossiliferous layers, are observable, as already stated. These I have observed most distinctly at different points on the high prairie between the Mississippi and Fever River, both in Wisconsin and Illinois; on the higher grounds at the Blackleg Diggings, on the line of the two States; and on the high ridge east of the Mississippi, north of Cassville. Throughout these higher districts, the diggings are in the upper bed of the upper magnesian. On approaching the centres of elevation, or the general northern outcrop, a zone occurs, where the flint bed occupies the surface, sometimes quite narrow, and at other times, particularly in the forks of rivers, more extensive; the upper bed either thinning off gradually, or terminating more abruptly. In the former case, the diggings are often both in the upper and flint bed, near the outcrop of the latter. Still nearer the centres of elevation or the general northern outcrop, the lower bed of the upper magnesian occupies a similar zone of the surface, and here the same remarks are applicable as in the former instance. The blue limestone, and the strata underlying it, are generally exposed, in these centres, only along the sides of valleys and ravines, and rarely occupy any extent of surface. It would require long-continued observation to collect the facts necessary for a map exactly exhibiting the extent of the different strata occupying the surface. Such a map would be very useful, not only in determining the mineral value of property to some extent, but also the probable character of soils, from the underlying rock.

In the north-eastern part of the country examined by me, along the valley of Sugar River, and west of Rock River, between Madison and Janesville (south of the outcrop of the lower magnesian), there has been obviously an extensive removal of the upper strata, but not accompanied, as far as I have observed, with such remarkable evidences of local elevation as in the mineral district. In the valley of the west fork of Sugar River, south-east of the Blue Mounds (in the town of Primrose), the lower magnesian rises, however, near thirty feet above the bottom of the valley, while the surrounding high prairie ridges are covered by the upper bed of the upper magnesian. From the valley of Sugar River, north-east of Exeter, to Rock River, north of Janesville, I have observed no appearance of the upper magnesian. It may occupy the surface of the high prairie, extending west from Rock River, at and south of Janesville, but I have not yet had an opportunity of determining it. It however occupies the surface farther west, at least to the east of Monroe. The country north of that prairie, to within 5—6 miles of Madison, is traversed by numerous ridges, more or less isolated, with intervening basins; the higher ridges, so far as I have examined them, overlaid or capped by the blue limestone, and underlaid by the upper sandstone; the lower swells sometimes formed entirely of the upper sandstone. I have observed

the lower magnesian in only one instance in this district, where it was reached in an excavation for a well, at sixteen feet, in the plain on the east side of Sugar River, near the foot of an isolated tabular ridge, formed of the upper sandstone overlaid by the blue limestone. The blue limestone, in this district, sometimes presents all its beds distinctly, as in Donaldson's quarry, near Stoner's prairie, south-west of Madison, and in the Monterey quarry at Janesville, and sometimes only the middle and lower beds, or the lower bed only, according to the degree of denudation. In this district, the middle bed of the blue limestone has presented only a uniform fine-grained rock, resembling the upper portion of that bed in the mineral district. The compact glass rock has not occurred distinctly. Along the northern border of this district of the blue limestone and upper sandstone, extends a narrow ridge, occupied by the lower magnesian, presenting the peculiar characters of its middle bed, as observed in the mineral district. This ridge ranges E. S. E. along the south side of Dead Lake, and in an E. S. E. direction, by the map, from the Wisconsin near Arena. The sandstone quarries, west of Madison, lie 2—3 miles north of it, in a parallel range, as if in the position of the lower sandstone.

I have made these statements in order to correct an error in former reports, which presents a singular anomaly in the outcrop of the strata, and might lead to embarrassment, particularly in examining the eastern border of the mineral district. It has been stated by Mr. Lapham, in a communication in Foster and Whitney's Report (P. II. 1851, p. 169,) that the limestone at Janesville is the lower magnesian, underlaid by the lower sandstone. This has been adopted by Owen, in the map accompanying his last Report (1852), in which the outcrop of the lower magnesian is drawn from a point near the Wisconsin River, north of the Blue Mounds, along the east side of Sugar River, south-east to Janesville. The limestone at Janesville is clearly the blue limestone, presenting its three beds with their distinctive characters and their peculiar fossils. The underlying sandstone has as strictly the characters of the upper sandstone, particularly at its junction with the blue limestone. The same is true at Donaldson's quarry, where all the beds of the blue limestone are present, well characterized, and the sandstone underlying that and the other more northern localities of the blue limestone is equally marked as the upper sandstone.

[To be continued.]

ART. IV.—ON THE MANUFACTURE AND APPLICATION OF VARIOUS PRODUCTS OBTAINED FROM COAL (COAL-GAS EXCEPTED). BY PROF. F. CRACE CALVERT, F. C. S., &c.*

MR. CRACE CALVERT commenced his paper by stating that there were two distinct theories by which the formation of coals was explained; and in consequence of the geological influences to which they had been submitted, the coals presented great differences in their composition; as, for example, some were entirely composed, as anthracite, of nearly pure carbon, whilst others contained but a small proportion of fixed carbon, and a large proportion of tarry substances or hydro-carbons; such, for example, as cannel, bog-head, and Albert coal, from New Brunswick; and this led Mr. Crace Calvert to divide coal into three distinct classes, having regard to the distinct applications which they received in manufactures; the first class being employed as fuel in generating steam; the second for making coke; and the third kind chiefly for producing gas. The most valuable researches which had been published upon the composition of coals, and the relative value of different kinds, principally for generating steam, were published in a voluminous report of experimental investigations on coal for the steam navy, by Sir H. De la Beche and Dr. Lyon Playfair, and presented to the House of Commons, by royal command. The results of those investigations exemplified that most valuable information might be obtained from scientific researches on the relative value of different kinds of this important fuel for generating steam in manufactories, the steam-navy, &c. In fact, the English navy had already derived great advantages from the elaborate researches of the scientific gentlemen before mentioned, to whom, no doubt, was due the credit of anthracite coal being now extensively used by our large steamers in their voyages to the Cape and Australia. That great improvements were yet to be made in the construction of the apparatus for generating steam, and of economy in the use of particular kinds of fuel, was evident from the fact (mentioned in the report before alluded to) that the combustion of one pound weight of coal in the best constructed boilers of the present day, converted into steam only 10 lbs. of water at a temperature of 212 deg., instead of 14 1-2 lbs., which was the quantity demonstrated to be practical of realization.

The following table is an abstract of the researches contained in the report above-mentioned:

* From the Journal of the Society of Arts, November, 1854.

Actual and Theoretical Duty of Coals.

	Practical. lbs. of Water converted into Steam at 212° by one lb. of Coal.	*Theoretical.* lbs of Water at 212° converted into Steam-coke left.	*Theoretical.* Total lbs. of Water converted into Steam by one lb. of Coal.
Graigola,	9.35	11.31	18.563
Anthracite,	9.46	12.554	14.593
Pentrefelin,	6.39	10.841	18.787
Powel's Duffryn,	10.15	11.184	15.092
Three-qr. Rock vein,	8.84	7.081	13.106
Pontypool,	7.47	8.144	14.295
Ebbw Vale,	10.21	10.441	15.635
Dalkeith Jewel Seam,	7.08	6.239	12.318
Fordel Splint,	7.56	6.56	13.817
Broomhill,	7.30	7.711	14.863
Slievardagh (Irish,)	9.85	10.895	12.482

Another fact ascertained by the researches and experiments of the same gentleman, was, that certain kinds of coal were superior for generating steam rapidly, by their quick combustion; while other kinds were better employed for steaming on long voyages, from their slow combustion.

The ordinary kind of coal was, generally speaking, divided into two classes; the best quality being employed for household use, while the inferior was used for generating steam. Great economy had resulted of late years in the use of household coal, owing to the extensive use of coke in manufactures; this class of coal being sifted at the pit's mouth, the small and less valuable part was used for making coke, while the lumps and larger pieces were employed as household fuel.

It was necessary to say a few words on the manufacture of coke. The best coals for making coke were those which would yield from 60 to 75 per cent. of coke, with but a slight trace of sulphur, and which had the property of caking or melting together, so as to form a solid mass in the oven. This superior quality of coal was found near Newcastle-upon-Tyne, and in Lancashire; the best coke being made from what is called "Mountain Mine." These superior cokes were characterized by their high density, the brilliancy of their appearance, and their superior power of generating steam. He had noticed, from long observation of the manufacture of coke, that the best kind was made when three or four feet in depth of coal were introduced into moderately large ovens; allowed to cake for 60 to 90 hours, and cool for 24 hours previously to being drawn.

He had succeeded of late years in discovering a simple process for removing sulphur from coke, thereby greatly enhancing its value for melting cast iron in the cupola, and increasing the bear

ing strength of the metal. This was proved by the results obtained by Mr. William Fairbairn, and Messrs. Fox & Henderson. The application of the same process to blast furnaces had enabled Mr. Crace Calvert materially to improve the quality of the iron obtained. Mr. Crace Calvert next drew attention to the third class of coals, namely, those employed principally for making gas. These coals, viz., cannel and bog-head, although for commercial reasons Newcastle and other coals of that character are used, were remarkable for yielding in addition to about 30 per cent. of an inferior coke, a large quantity of gas, and numerous other products of greater or less value. The accompanying table would give an idea of the numerous products which chemists had ascertained to exist in the substances distilled from coal:—

Gases.	*Liquids.*	*Solids.*
Bicarburetted hydrogen,	Bisulphuret of carbon,	Naphthaline,
Propyline,	Ammonia,	Para naphthaline,
Light carburetted hydrogen,	Eupion,	Paraffine,
Hydrogen,	Paraffine oil,	Pyrene,
Oxide of carbon,	Aniline,	Chrysene.
Sulphuretted hydrogen.	Leukol,	
	Carbolic acid,	
	Benzine,	
	Napthine,	
	Napthole.	

It will be perceived from this table that the products obtained from coals were divisible into three classes, namely, gases, liquids, and solids. He did not intend to dwell upon the first class—the gases—which subject was so extensive that it would require to be treated in a separate paper. With respect to the solid products of coal, he would first allude to the coke which was obtained in making gas.

The coke generally obtained from gas-works was very inferior. Great efforts had lately been made to obtain the various products of coal, and also to manufacture good coke for cupola and railway purposes, at the works of the London Gas Company, but he was not aware of the exact results obtained.

The liquid products from coal could be divided into two distinct classes, the aqueous portion and the tarry portion. The aqueous portion was valuable chiefly for the ammonia which it contained, and which was put to the following amongst other uses: In the first place it was bought by chemical manufacturers, who obtained from it sulphate of ammonia for agricultural purposes, sal ammonia for soldering, and which was also used in calico and print works in the production of a style of prints called "steam goods." From these two salts was obtained hartshorn, which was extensively employed in pharmacy.

Ordinary coal gas liquors was often employed to obtain by disillation common ammonia, which was much used in dye works;

also to produce, with lichens, beautiful coloring matters called orchill and cudbear, valuable for the production on silk and wool of delicate purple hues. The production of this color and the influence of ammonia was exceedingly interesting, on the ground that the coloring principle called orcine was colorless until acted upon by the oxygen of the air and ammonia. If to this ammonia a fixed alkali be added, then no more orchill or cudbear was produced, but litmus, which was now much used in chemistry as a test for acids and alkalies.

One of the most interesting and useful of the applications of ammoniacal liquors was in the preparation of ammoniacal alum. The manufacture of this substance had become very extensive of late years. At the chemical works of Messrs. Spence & Dixson, near Manchester, 800,000 gals. of ammoniacal liquor were annually consumed in the manufacture of ammoniacal alum, the ammoniacal liquor being obtained from the extensive gas-works belonging to the corporation of Manchester. The manufacture of this substance, which was so valuable as an astringent, and also to the dyer and calico printer, furnished such a remarkable illustration of the value of chemistry in aiding manufactures and commerce, that he would explain briefly the method of producing it. To obtain this substance called ammoniacal alum, a refuse product of coal pits, known as aluminous shale, was heaped into small mounds and slowly burned. Shale was generally found in hard masses, which fell from the roofs of the coal mines, and the object of burning it was to render it porous and friable. The calcined friable mass was then placed in large leaden vessels, with sulphuric acid, having a specific gravity of 1.65, being the strength in which it was obtained from the leaden chambers. It was a curious fact that this sulphuric acid could be produced from another refuse found in coal mines, namely, pyrites.

The calcined shale and sulphuric acid were heated in these leaden chambers for about forty-eight hours, the liquor was then drawn off and put into another vessel, into which the ammonia generated from another refuse of coal, namely, the gas liquor, was was introduced in a gaseous state. Thus these three substances, the alumina from the shale, the sulphuric acid obtained from the pyrites, and the ammonia from the gas liquor, combined to produce ammoniacal alum, which then only required purifying by successive processes of crystallization to give it that remarkable purity in which it was furnished to the commercial world by Messrs. Spence & Dixson, and other manufacturers.

A great boon would be conferred upon agriculturists if the ammonia which was produced when coke was made in common ovens, were saved, as recommended by Dr. Lyon Playfair, who estimated that every hundred tons of coal would yield, on the average, about six tons of sulphate of ammonia. The quantity of coke made annually in England amounted to at least 1,000,000

tons, yielding, therefore, 60,000 tons of sulphate of ammonia. which might be made a cheap and valuable agent in agriculture. When the minimum advantages which manufacturers had derived from saving the ammoniacal products in gas-works were remembered, it ought to encourage coke manufacturers and engineers to exert themselves to effect the same. In so doing they would confer a great benefit on the public, as coke would thus be enabled to be sold at a lower price. It was interesting to reflect that, no doubt, at the present day, tons of salts of ammonia were made, where formerly pounds were imported into England, from a district called Ammonia, in Nubia, in Egypt, and which, in the form of sal-ammoniac, was derived from heating in glass vessels the soot which had been produced by the burning of camels' dung. The same line of thought might also be applied to alum, which formerly came entirely from the East, then from the environs of Rome, and now, through the application of chemistry to manufactures, the progress of human intelligence, the undaunted perseverance of our countrymen, was manufactured in England from what had been hitherto noxious and refuse products.

Mr. Crace Calvert next spoke of tar. This substance was generally sold to the tar distillers, who obtained from it a volatile fluid called coal naphtha, a light oil, composed principally of carbonic acid and a heavy oil of tar, a solid substance called pitch being also left in the retort. Mr. Crace Calvert then proceeded to state the applications which these various materials received. Pitch had of late years been used successfully by the corporation of Manchester in assisting to pave the streets. When the streets were repaved, a large quantity of this pitch, to which was added tar and asphalte, was heated in portable boilers in the street, and was poured, when in a hot liquid state, upon small pebbles or gravel between the interstices of the paving stones, which were thus firmly bound together and became so durable that the most frequented thoroughfares in Manchester, when thus paved, had not required repaving for several years. There was, however, this important sanitary advantage connected with the plan, and to which he wished to draw special attention, namely, that no impure matter and stagnant water could percolate through the impervious pavement and collect beneath, giving forth noxious effluvia, to the injury of the health of the inhabitants of large cities, and even causing dangerous epidemics. The importance of this process would be the more apparent when it was calculated what a vast surface area was presented by the streets of a large city.

This pitch had also of late been submitted by Mr. Bethell to a further distillation of retorts, which enabled him to obtain a porous, but at the same time a dense coke, and the oils which were distilled in this operation appeared to be such as might be employed to advantage as lubricating agents for common and

heavy machinery. Before passing to the various volatile products obtained from the distillation of tar, Mr. Crace Calvert stated, that tar had been applied lately, when mixed with gutta percha or india rubber, to insulate telegraph wires, and to prevent metals from being acted upon by the atmosphere.

One of the first products which came over in the distillation of tar, was a mixture of very volatile hydro-carbons, which had received the name of crude naphtha, and this, when again distilled, was sold under the name of naphtha, and was chiefly burned by the keepers of stalls in streets and markets. When naphtha had been mixed with turpentine, it was called camphene, and was burned in lamps in private dwellings.

When it was intended to apply this naphtha to more particular purposes, it was purified by mixing it with ten per cent. of its bulk of concentrated sulphuric acid, and when the mixture was cold, about five per cent. of peroxide of manganese was added, and the upper portion was submitted to distillation. The rectified naphtha found in the receiver, has a specific gravity of 0·85. This rectified naphtha was used to dissolve caoutchouc for making garments impermeable to water, known as Mackintoshes; and when sulphur was added, and the mixture submitted to steam having a temperature of from 400 to 500 degrees, vulcanized india rubber was produced.

Rectified naphtha was also used for mixing with wood naphtha, to render the latter more capable of dissolving resins for the production of cheap varnishes. When this rectified naphtha had been submitted to a series of further purifications, it had received from an eminent French chemist named Pelouze, the name of "benzine," which had the property of removing with great facility spots of grease, wax, tar, and resin, from fabrics and wearing apparel, without injuring the fabric, its color, or leaving any permanent smell or mark, as was the case with turpentine. Benzine had, through his (Mr. Calvert's) exertions, been introduced into England, and had been found most valuable in brightening velvets, satins, &c. The numerous uses to which this valuable product could be applied in manufactures, must in time render it of extensive employment in place of alcohol and other fluids, which were, generally speaking, too expensive for common commercial purposes. As an instance, he cited that at the present day in Yorkshire there was a large quantity of wool dyed before it was spun, principally for carpet manufacturers. It was then necessary to oil this dyed slubbing wool, as it is called, and up to the present time no means had been discovered of removing the oil without injuring the color, and thus this oil remaining in the fabric materially injured the brilliancy of the color, as well as rendered the carpets thus manufactured liable to become sooner faded or dirty. Now, by the employment of benzine, which had not the property of dissolving colors, the oil could be

removed from such fabrics, and the full brilliancy of the colors fixed on this slubbing wool be restored. He also stated that this benzine could be employed with advantage in photography, in removing the grease from daguerreotype plates. When this benzine was treated with strong nitric acid, it gave rise to a substance called nitro-benzine, which was every day becoming more and more employed as a substitute for essence of bitter almonds, was used for flavoring dishes, and communicating scents to perfumery, soaps, &c. It was interesting to observe that thus, by the triumphs of chemistry, a delicious perfume had been produced from the noxious smelling refuse of coal.

The next products he should mention which were distilled from coal, were those which had the name of light oils of tar, which remain on the surface of water, and which had been applied, conjointly with the heavy oils, with great success by Mr. John Bethell, to the preservation of wood from rotting. Wood which had been treated by Mr. Bethell's process, was extensively employed as railway sleepers, and wherever wood work was exposed to the influence of moisture and the atmosphere. The introduction of the fluid into the wood was effected by placing the wood in close iron tanks, exhausting the air, and then forcing the oil into the whole substance of the wood, under a pressure of from 100 to 150 lbs. to the square inch.

There existed in these light oils of tar a product highly interesting, called tar creosote, or carbolic acid, which possessed extraordinary antiseptic properties; such, for example, as preventing the putrefaction of animal substances. He (Mr. Crace Calvert) had applied it with success in preserving bodies for dissection, and also in preserving the skins of animals when intended to be stuffed. Owing to its peculiar chemical composition, he had also employed it successfully of late in the preparation of a valuable dye-stuff, called carboazotic acid, which gave magnificent straw-colored yellows on silk and woollen fabrics. The carboazotic acid prepared from the above-mentioned substance could be obtained very pure, and at a cheap rate, thus enabling the dyer to obtain beautiful yellows and greens, which were not liable to fade by exposure to the air, as was the case with most of the yellows and greens which were obtained from vegetable dyes. The advantage of the carboazotic acid, so prepared, was, that it was entirely free from oily or tarry substances, which had the property of imparting a disagreeable odor to the dyed fabric. The intense bitter which this acid possesses, had induced him to have it tried as a febrifuge, and Dr. Bell, of Manchester, had succeeded in curing several cases of intermittent fever by its aid, in the Manchester Infirmary. He had also placed some of this substance in the hands of eminent physicians throughout the country, and he hoped shortly to ascertain that it was of real value as a substitute for that expensive medicine, sulphate of quinine.

He had lately applied carbolic in a manner that offered advantages to dyers and calico printers. It was well known that extracts made from tanning matters could not be kept for any length of time without undergoing deterioration, in consequence of the tanning matter which they contained becoming decomposed, and transformed by a process of fermentation, into sugar and gallic acid; which acid, he had ascertained, not only had no dyeing properties, but that, on the contrary, it was injurious, from having a tendency to remove the mordants which were employed to fix the colors on the cloth. It was also known that gallic acid possessed no tanning properties. By adding a small quantity of carbolic acid to the extracts of tanning matter, they could in future be kept and employed by the dyer as a substitute for the substance from which they were obtained—by which would be gained the double advantage of saving labor, and obtaining a better effect from the tanning matters.

The third substance which passed off in the distillation of tar was called heavy oil of tar, which was used by Mr. Bethell as above stated. This substance contained a singular organic product, first discovered by Dr. Hofmann, of London, and called by him "kyanol" or "aniline," which possessed the property of giving, with bleaching powder and other agents, a magnificent blue color. This fact led him (Mr. Calvert) to observe that this last-mentioned substance, as well as carboazotic and indigotic acids, being produced as well from indigo as from coal-tar, proved the great similarity and chemical connection which existed between the products of tar and those of indigo, and induced him to believe it extremely probable that those products would be employed within a few years as substitutes for indigo and madder. Laurent had succeeded in obtaining two products from naphthaline which had a great analogy to the coloring principles of madder. A substance, for instance, called chloronaphthalic acid had the same composition as the coloring matter of madder, and would be identical if the hydrogen gas was substituted for the chlorine which the acid contained. Hence the chloronaphthalic acid had the property of giving with alkalies a most superior red color.

When the coloring principle of madder was treated with nitric acid, a substance called alizaric acid was obtained, which was identical with a substance also obtained from naphthaline called naphthalic acid. Naphthaline was a solid white substance, which distilled in large quantities during the distillation of tar.

An interesting fact has been discovered by Mr. James Young, of Glasgow, namely, that if coals were distilled at a low temperature, the products obtained were different from those which were produced when coals were distilled at a high temperature, as was the usual custom in the manufacture of gas. Without entering into all the details on this point, he would mention one

of the most striking differences of results, namely, that Mr. Young obtained in place of the naphthaline, a valuable lubricating agent, called paraffine, a solid substance, and a large quantity of carburetted hydrogens were also distilled, which, being free from smell, were valuable for commercial purposes, and had received the general name of paraffine oil; or, as Dr. Lyon Playfair remarked in his report of the Great Exhibition of 1851, it was "liquified coal gas." This paraffine oil, when mixed with other oils, was now most extensively employed in the cotton-mills of Manchester, and the neighborhood. Solid paraffine was also obtained in the distillation of peat, and was employed for manufacturing candles, there being added to it about twenty per cent. of wax. These candles were remarkable for their transparency and the pureness of their flame. Mr. Crace Calvert exhibited specimens of these candles, and of the various substances mentioned in his lecture, and by which he had illustrated his remarks throughout, and exemplified the truth of his facts and statements. He stated that he was indebted to Mr. Edward Binny, of Manchester, for the collection of coals which were on the table, and to Mr. Clift for most of the valuable specimens of products obtained from coal-tar.

(To be continued.)

ART. V.—MINING IN WALL STREET.

ALL mining operations aregenerall yconsidered as divided into two classes: one is well known and often spoken of by the term, legitimate mining; the other is seldom mentioned by any particular designation, although when alluded to, it is recognized by all. According to the rules of language the true appellation of this latter class should be the opposite of the former, and, if the one is termed *legitimate* mining, the other should be called *illegitimate* mining, meaning thereby a sort of bastard fruit of one of the natural and healthy pursuits of society.

Now legitimate mining operations may be carried on with a poor mine as well as with a rich one, and so with illegitimate mining operations. The nature of the mine may be a circumstance independent of the character of the operations by which it is conducted. Although if the mine is rich and the operations illegitimate, the spawn is apt, for a time, to flood Wall street.

Both classes of operations are commenced in the same manner, and when the young fledgling first comes into life it is almost impossible to detect, by careful inspection, what genus it is of. The first step is always to purchase a mineral tract of land, and, in legitimate mining, too much caution and experience cannot be

exercised to test and determine its richness. In this class of operations this is one of the most important features of the case. Far better is it to reject a hundred mineral locations where there may be indications of poverty, or even defective indications of richness, in order to secure a rich mine; for, in this extensive country, the rich mines will not all be found out in the next century. Far better is it to wait long and examine carefully, than to hazard the capital, the patience and perseverance which is peculiar to this class of operations. On the other hand, with the bastard class of operations, the course to be pursued is much easier, and the thing is done, as it were, by a short cut. The best and usual mode of proceeding is somewhat on this wise: Get the earliest news which is possible, of the existence of any mineral tract, and, if it is described in most magnificent terms, especially by some "gentleman at large" who was never down a shaft in his life, you may be sure it is just the mine wanted. Then, with carpet bag in hand, quietly slip into the railroad cars, after having told your wife you will be absent only for a night, and go, with all the speed of steam, to the sacred spot. When there, go unobservedly out over the tract yourself; it is no matter whether you ever have seen a mineral tract in your life or not, you have seen specimens of ores in cabinets and know the "look;" observe whether the rocks are thrown around in admirable confusion, indicative of violent geological action; whether they run in right lines, and easterly and westerly, and show their backs occasionally on the surface, as a porpoise does in water, and whether they dip considerably, which is a good sign of ore, and that they have gone down to hide it, leaving only some sprinklings near the surface. For the fianl and "cap sheaf" indications of a rich deposit, go among the farmers in the neighborhood and examine the specimens they may have to show. If these are big and bright, then the rule is to buy the property; be sure and buy the property; do not return without the papers safely locked in the aforesaid carpet bag! It is of small comparative consequence respecting the facilities for working the mine, or the easy access to public thoroughfares, or the supply of timber and water. All the treasure is to be dug out in Wall street. These particulars are hardly looked into there. Thus the property is secured. It may possess a most rich mine, or an indifferent one. In the one class of operations this point is one of vital importance; in the other it is of less moment.

It is unnecessary to give a history of all the details of the proceedings. There are two or three points of chief importance for success in these illegitimate operations which should be mentioned. These are the board of directors, the amount of capital, &c. A board of directors, consisting of serious, calm, experienced, judicious working men, is not to be thought of. Such a board will answer for legitimate mining operations where capital is to be put into the mine and the ore patiently dug out, but they will be sure

to fail if set to work in the strata of Wall street. On the contrary, a board for these operations should be composed of men of good wind and a plenty of it, a tropical imagination, and a keenness of eye which can see a thing where it does not exist—men, too, who are not tarnished with the plain, homespun, frank address of sturdy honesty. Under the direction of such a board a shaft can be sunk in Wall street, from whose depth the treasures of many a bank can be raised to "grass!" The amount of capital stock is very important. In the first place, there is a certain amount to be given to parties to induce them to enlist in the concern. Then there is an amount to be given to others for getting up a market. Next, it is to be considered at how much below par the stock can be got off; so that the capital must be such a magnificent sum that, after all these discounts are allowed, the prime operators can each pocket a fortune—not to speak of the nominal amount which is to be set apart for working the mine. A million dollars is generally thought to be about right. Some, more audacious than the rest of mankind, think one and a half, or even two, is none too much, especially if the mine is a good one and shows well; while others, having some remnants of natural modesty not yet eradicated, fall a trifle under a million.

By turning back to the records of the times, ten and twelve months ago, it will be found that nearly one hundred mining companies were located and in full operation on the Great Wall Street Vein and its Spurs. The capital stock represented by them exceeded fifty million dollars, which is more than the banking capital of the City of New York. The stock of nearly sixty of them had been sold in the Mining or General Stock Boards—as reported. These securities were things of repute. They would buy real estate, houses, carriages, pay board bills, tailors' bills, and also command cash, as many a "sore head" now bewails. Of all this amount of stock then offered for sale there remains that of only a few legitimate companies which can be sold to-day for cash as good securities, unless, perhaps, two cents or so is offered per share, and at that price for many companies' stock, buyers are not to be found. As to the offices, they are either locked up or let to other tenants, after the furniture has been removed and the occupants flown; some have found a lodgment in the penitentiary and some are nowhere. "The places that once knew them will know them no more for ever."

But these are the extreme cases and the number is few. The experience of the past has taught the lessons of wisdom. With many, legitimate mining operations now present the only path by which to recover from the wreck of both fortune and character. Happily in most of these illegitimate cases the mines are good, and if money enough can be obtained to work them aright, prosperity is to be discerned in the future.

Next comes the bursting of the bubble by a development before the public gaze of the secret transactions. Men of character

and wealth have not escaped these snares, and they demand a full investigation of the past. In some cases this is obtained, and the wrong is held up before the world in all its damning deformity. Take for instance the following, which is a summary of a single case:

"The Stockholders of the Gold Hill Mining Company held a meeting April 27th, to receive the report of the Investigating Committee, and to vote upon making an assessment for the purpose of paying off the debt of the Company. A large amount of stock was represented, and by a vote of about 106,000 shares out of 176,000, which are in the hands of the public, an assessment of 78 cents per share was laid, under the authority of an Act of our Legislature, obtained at the last session. This amount will, it is stated, pay off the debts of the concern of every description, and leave the mine and machinery entirely unembarrassed. The Company own 24,000 shares of its own stock, which the meeting voted should never be issued, unless authorized by a vote of the stockholders, at a meeting called for that purpose. The report of the Committee was very full, and proved conclusively that the dividends paid by the Company were never earned. These dividends were two per cent. every sixty days; but the report shows that in some of these dividend periods the mine had not yielded a profit of $1,000, while the dividends amounted to some $17,000 or $18,000. It would appear that every dollar of gold taken out, and in most cases even more must have been borrowed, was forwarded to New York for the payment of the dividends, while the mine was run in debt for all the working expenses, construction, &c. The aggregate dividends declared, we think, was about $95,000, and the gain of the Company only about $30,000. The debt of the Company is $128,000 in round numbers, including the balance of the purchase money. The working of the mine is now being carried on with vigor, and the gross yield of the first three weeks of April was, if we remember the figures correctly, some $15,000. Of the richness and value of the mine there appears to be no doubt, and properly and economically managed, it was the opinion of one of the Committee of considerable mining experience, that it could be made to pay six per cent. per annum on par. Considerable discussion took place upon the Report, but the meeting separated without any vote of censure upon any one, or without recommending any change in the management."

In this magazine, Vol. II, No. 6 (June 1854), page 642, is the following statement:

"At the annual meeting of the Stockholders of the Gold Hill Mining Company on the 9th of May, the following gentlemen were elected Directors for the ensuing year, viz:

Isaac H. Smith, Thomas Williams, Jr., Henry W. Belcher, Amos M. Sackett, John P. Howard, of New York; William L. Beal, and James Fowler, of Boston; and Moses L. Holmes, of Gold Hill, North Carolina. Isaac H. Smith was re-elected President, and Augustus Brand, Secretary."

It is not easy for outside persons to designate who are the active managing individuals, or who are the idle or inefficient members of a Board of Directors; nor is there any other position tenable than the broad ground that every man who allows his name to be used as a member of a Board of Directors, is responsible in reputation and character for the general management of business by that Board. If an individual has too much private business to discharge faithfully the duties of a Director, or if he is incompetent as, alas! far too many are in the Boards of most all our

incorporated companies, then certainly it is a fraud upon the public to place such a name in the list of Directors. In this view of the case, and it is the only just view which can be taken, we see no manner in which any Director of an illegitimate company can expect to screen himself from the infamy of its management.

In the Revised Statutes of this State, Vol. II., Part IV., Chapter I., Article IV., sections 53–54, is the following:

§ 53. Every person, who, with intent to cheat or defraud another, shall, designedly, by color of any false token or writing, *or by any other false pretence*, obtain the signature of any person to any written instrument, or obtain from any person, any money, personal property, or valuable thing; upon conviction thereof, shall be punished by imprisonment in a State prison not exceeding three years, or in a county jail not exceeding one year, or by a fine not exceeding three times the value of the money, property or thing, so obtained, or by both such fine and imprisonment.

§ 54. If the false token by which any money, personal property or valuable thing, shall be obtained as specified in the last section, be a promissory note or other negotiable evidence of debt, purporting to have been issued by or under the authority of any banking company or monied corporation, not in existence; the person convicted of such cheat, may be punished by imprisonment in a State prison not exceeding seven years.

It should be stated that there is at present a considerable number of companies or associations awaiting the first genial rays in financial affairs, in order to burst their buds and come forth in full blossom and locate upon the Great Wall Street Vein. With them, the first object is to sell their stock, and the price it will command is a matter of more anxiety than the character of their mine. It is to be hoped that the experience of the past will cause all the unworthy ones speedily to meet that fate, which sooner or later must overtake them.

Here let us pause for a moment, and behold the astonishing spectacle presented in a country where all possess intelligence and the rudiments of education, where the principles of integrity and honor in business are recognized and appreciated, where virtue is rewarded, and even the principles of religion cultivated in a high degree. It is not our duty to excuse or apologize for this state of affairs, although existing in a pursuit to which our pages are devoted, and in which our predictions and warnings have been fulfilled to the letter. We can explain, however, the manner in which all this has come to pass and point out the cause; which is indeed a part of the duty of this magazine. An illustration or two will best serve our purpose. Suppose a few individuals should associate together in conformity to the law of incorporations in this State for the purpose of banking. They locate their bank, select their directors and officers, and open their doors to the public for business. The public first seek to know the character and capabilities of the directors and officers, and they are told that not one of the individuals to whom the bank belongs and in whose hands is its management, knows any thing either theoretically or practically of banking business. Now could such a

·k get credit; could it do business? The question is so preposterous that it must appear to every one to be absurd. Again, suppose a few persons associated together to establish and conduct a commercial house, but not one of those persons has any knowledge or experience in business; would such a house be worthy of confidence, could it command success? Not at all. But how stands the case in mining? A few individuals associate together for mining purposes, not one of whom has any scientific or practical knowledge of the object before them, one, indeed, which requires more extensive and profound attainments than any other pursuit. They spread their sails with a million dollars as declared capital. Now, who inquires whether those men possess the requisite knowledge and experience for their business, or whether they are entitled to credit? No one. Thousands rush eagerly into the trap set for them, and when every thing has disappeared but the worthless scrip in their pockets, they cry out at their own folly and madness. The reason of all this is apparent. In the one case the public mind is informed and public sentiment settled, and only those enterprises which are organized in accordance with this sentiment can succeed. In the other case, the public mind, overlooking the fact that the same general rules should govern in all business, has been uninformed, and no standard of opinion settled; hence every thing that promised largely has been favorably received, and the consequences are manifest.

The ground advocated in the pages of this magazine is, that no person is suitable for a director or managing officer of a mining company, who is not both scientifically and practically acquainted with this pursuit. In the hands of such men even a poor mine can be economically conducted and made profitable. This is the principle which governs in all the established pursuits of society, and only by its rigid adoption with the public can mining in this country be placed on a secure and prosperous basis. In many of the illegitimate companies before noticed, it will be found on investigation, that neither officers nor directors have any other than the most superficial knowledge of the science of their business, and that they are utterly destitute of all experience. The importance of this knowledge and experience cannot be too strongly urged. Professors and engineers may be of much service, but they are seldom members of the company or have any controlling interest. They never can supply the deficiency of knowledge and experience on the part of the officers.

A well informed public opinion on mining, exacting faithful and honest representations, knowledge and experience, is hardly developed as yet in this country. Indeed its importance is only imperfectly felt, or its necessity appreciated. Happily, however, it is in progress, and the day is not distant when it will be every where recognized.

(To be continued.)

Art. VII.—REPORT ON THE SOUTH ECHO LOCATION OF THE CANADA MINING CO. By J. D. Whitney.

The South Echo Location is situated on the south side of Echo Lake, and extends for five miles along that Lake, and the river of the same name, in a direction a little north of east, and south of west. To the south of the lake it occupies a width of two miles. Echo Lake is connected with Lake George, the St. Mary's River and Lake Huron, by Echo River, and the distance from the western line of the location to Lake George, through which steamers are constantly passing between Lake Superior and the lower Lakes, is about eight miles. There is a sufficient depth of water in Echo River to allow of large scows being brought up to the Lake. Fox Creek, a branch of Echo River, runs through the location, furnishing an abundance of water for washing ores and other purposes. The warehouse formerly used on this location was situated a short distance above the junction of Fox Creek with Echo River, and was connected with the houses at the mine by a road of about one and a half miles in length. This was done in order to secure a level route, as a road from Echo Lake, directly south, although only a mile in length, would have made it necessary to cross the trap range some 400 feet high.

The whole northern portion of the location is occupied by a high range of trappean rock, which rises gradually from the Lake to the height of from 400 to 500 feet, and faces the south with a precipitous front. From one half to two thirds of a mile south of this range, is a second one nearly parallel with it, and rising to about the same height, but less regular in the development. The south line of the location probably passes along near the base of this southern range, as indicated on the diagram. Between the two heights is the valley of Fox Creek, which is about half a mile in breadth, and is generally pretty level, with here and there an isolated knob rising from it. The whole of the location is covered with timber,—maple, birch, spruce and cedar are the predominating trees; there is some oak, ash, and elm. There is not much pine on the location or on the lands near it. The soil on the north side of the north range, and in the valley between the ranges, is good, and the location is in this respect more favored than many others in this region.

The rock, which occupies almost the whole of the location, is a hornblende trap, in some places passing into syenite; it is usually dark colored, and somewhat crystalline—sometimes largely so. It is quite similar in character to that in which the Bruce Mine veins occur. Its lines of bedding dip to the north. A pretty heavy band of limestone crosses Echo Lake, and occupies a part of the northern side of the location. It is overlaid by a

syenite conglomerate and trap, which rise in bold cliffs on the north side of the Lake.

Several veins have been discovered on this location. There appear to be two systems of veins, one of which runs parallel with the formation, while the other crosses it at a considerable angle. The veins of the last mentioned class seem generally to be the best defined, although some of the veins running with the formation have been traced so far, and found to be so regular, as to lead to the belief that they are quite reliable. The veins thus far discovered are almost entirely confined to the western half of the location. The character of the formation on the eastern portion is the same as farther west, but the covering of drift, and superficial material, is greater, so that there is more difficulty in tracing the veins. These will be noticed in order, so far as they are worthy of mention, beginning at the extreme western end of the location.

Vein No. 1.—This is one of the lodes which is parallel with the strike of the formation. It shows itself in the end of the bluff, near the west line of the location. It has been opened along the surface for a distance of about 100 feet in a direction about N. 83 E. It varies from one foot to thirty inches in width, and carries a small amount of yellow ore of copper, with some iron pyrites. It dips nearly vertically.

Vein No. 2.—This vein lies a little further to the east than No. 1, and is seen near the summit of the bluff on the south side. It bears N. 15 W. running diagonally across the formation, and dips to the east, nearly vertically. It is from eighteen inches to three feet in width, and has well defined walls with selvages of flucan. Its gangue is almost exclusively quartz, and it carries yellow copper ore disseminated through it in a small quantity. It has been opened for about the same distance as No. 1.

Veins Nos. 3 *and* 4.—These two veins are only about 100 feet distant from each other. Both cross the formation, have well defined walls, and have been traced for a considerable distance. No. 3 dips to the east, and No. 4 to the west, so that it would appear that the two will be found to intersect at no great depth. Vein No. 3 is from two to four feet in width, and shows considerable yellow copper ore disseminated through a quartzose veinstone. No. 4 is from one to four feet in width, and has been traced on the surface for a distance of 800 feet. Both the veins were first opened high up in the bluff, and they have not been traced to a great distance downward, as the face of the cliff is covered with a heavy salus; but as far as they were opened, they appeared to improve in depth, both of them showing considerable copper pyrites in a quartzose gangue. They are so situated, that a drainage of 250 feet may be laid by driving in upon them from the base of the cliff.

Vein No. 5.—About half a mile east of Nos. 3 and 4. It is

seen in the face of the cliff, and has been traced back some distance to the north; it bears N. 5° W. and dips to the east about 60°. The width is from two to five feet, with a fair per centage of yellow copper ore disseminated through the quartzose veinstone. It could be drained at a depth of between 200 and 300 feet, by an adit level driven in from the base of the cliff on the course of the vein.

Vein No. 6.—This appears to be the largest and most promising vein, yet discovered on the location. It runs parallel with the formation, and has been opened at various points for a distance of nearly a mile along the summit of the bluff. It is very well defined, and varies in width from two to eight feet. At one point where it is well exposed by a break in the range, it is very wide and well charged with copper pyrites; at this point, an adit level could be driven so as to cut the lode at the depth of 100 feet.

Vein No. 7.—Has been opened for a short distance along the surface, and found to carry a little ore. It lies north of the old works. It is not unlikely that it may be a branch of No. 6.

Vein No. 8.—Appears to be a branch of No. 6. It is from one to three feet wide, and contains a little ore.

Vein No. 9.—This is the vein on which some work was done in 1847, and it is the only one on the location, on or about which any work has ever been done previous to 1854. It is situated on a small upheave of trap in the valley near the base of the main range of bluffs, and which is only a few rods in diameter. The vein is parallel with the formation and dips with it to the north. It can be only traced on the surface for about 200 feet, as the ground is low and deeply covered with soil around the knob. It is about three feet wide on the surface, and contains a small quantity of yellow ore. A shaft has been sunk upon this vein to the depth of about sixty feet, as is estimated from the size of the burrow. A portion of the ore, and of course the best portion, has been removed; but it is apparent from what remains on the surface that the vein must have improved considerably in depth, as there are some 30 to 35 tons of ore upon the surface, estimated to yield from 3 to 4 per cent of copper. I learned from Mr. Palmer who resides near Sault St. Marie, that the lode in the shaft improved constantly in descending upon it; and I saw in his possession pieces of almost solid ore, which were thrown out by the last blast before the mine was abandoned.

There are two houses at this place, one of which is of no value; the other might be repaired at a small expense so as to be inhabitable.

There are several other quartz veins on the location; but the above are the principal ones so far discovered.

On the whole, I consider this location as one of great value, and would recommend the expenditure of a sufficient amount of money upon it to thoroughly prove the most promising of the veins.

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ART. VIII.—THE KINGSTON COAL MINES, PEORIA COUNTY, ILLINOIS.—BY CHARLES S. RICHARDSON, MINING ENGINEER.

To obtain a more comprehensive view of this valuable property, it becomes necessary that a brief outline of its geology should precede this report, in doing which I will endeavor to be as concise as the nature of the case will admit. Those unacquainted with the State of Illinois, must be informed that the course of the Illinois River, on the left bank of which Kingston is situated, traverses an extensive plain, rising at the rate of sixty feet in 200 miles. It is undulated occasionally with ranges of low bluffs; these have evidently been formed by the natural process of denudation; the annual wearing away of the surface in gullies and ravines, leads to the discovery of the coal. From Kingston to Lasalle, a distance of seventy miles, the strata may be called horizontal or nearly so. In my examination no evidences have been met with of volcanic or other local disturbance, neither is there any sinking or uptilting of the rock series; they repose void of change, and remain the same as when the waters left the land at the close of the cretaceous era. There is nothing peculiar in the character of the stratum, it is composed of the same material as most of the coal basins in Europe, and may be classed as some of the latest series; the strata alternates with argillaceous earths; stiff clays; sandy clays; post or fine-grained sandstone; calk sandstone; shales; gray lime; coralline limestone, or a limestone composed principally of shells and marine exuviæ; soft blue clay slate; black slate; fire clay; ferruginous clays and rocks; chert; and compact yellow and gray sandstone; the black slate strata is only about one foot thick; this lies immediately on, and forms the roof of the coal seams. It is highly charged with sulphur, and contains a large quantity of those nodular concretions, called by the working colliers here, "nigger heads;" they are mostly of a flattish oval form, and vary in size from three inches to three feet; their composition is silica, sulphur, iron, and arsenic; instances occur when the black slate is quite bituminous. At Kickapoo Creek a six-inch seam was cut this winter that was found to be a semi-cannel coal; it burns with a strong smoky flame, and leaves a gray ash; its residue is lime and alumina.

Between geologists and mining engineers, a difference of opinion will exist in the classification of the rocks of this vast coal basin (if such a limited appellative can be given to the coal fields of the Illinois); externally they appear identical, but a close examination will show they differ; the line of demarkation is certainly very faint; but for the purpose of distinction, I shall denominate those above the first bed of limestone, that lie on the black slate, the cretaceous group, being by far the most modern

of the rock series, and containing, with the exception of pure chalk and brit, all the constituents of that formation. The strata of the coal measures belong of course to the carboniferous system, or formation: their difference may be noticed by the introduction of shales; ferruginous and indurated clays now come in, the strata becomes much thicker, and near the seams more sulphurous; the sandstone assumes a more compact and silicious character, with thin seams of chert; the fire clay, which forms the floor of the second coal seam, is quite hard; this is succeeded by a heavy stratum of yellow post, being a calcareous semi-sandstone, but not very hard; it is succeeded by a gray, hard, ferruginous stratum several feet thick, five feet of which is much like soapstone; below this come in various clays and sandstones, most of them impregnated with lime. These lie on a thick stratum of semi-limestone rock; it contains fossil shells, and other marine infusoria; its thickness is unknown, but that it is over ten feet thick is well known, a bore hole having been put down into it that depth. I, however, estimate it at least from thirty to fifty feet thick; below nothing is known. The flatness of the stratum prevents any calculation being made of its thickness, as nothing is shown at the outcrop whereby to ground any safe estimate thereon; we, therefore, have nothing but analogy to form our opinions upon, and those I have given in the after part of this report are derived from such data.

The Illinois River in Kingston is one eighth of a mile wide, and about eight feet deep in the channel at summer water level, but the distance across between its original banks is nearly three miles. The intervening space not occupied by ponds of water or stagnant pools, is a low marshy flat about six feet above summer water level; it is covered with a low growth of underwood, and a variety of timber trees of the soft wood quality. The soil is purely alluvial; the bluffs on the north side at Kingston are 176 feet high; they do not rise very precipitously, but slope at an angle of 30° with the horizon; these slopes, and meadows below them, are formed by the accumulated detritus of surface disintegration. Above the bluffs on either side commence the prairies; on the south side of the river the bluffs are not so high; they are not formed of solid rock at this spot, being nothing more in many places than sand drifts; the prairies on the north are covered with clay and marl, and those on the south with sand; they are locally denominated clay or sand prairies. The causes that have led to this unconformity of super-soil must be traced to the diluvial era; for the surface of the whole country has assuredly been subject to great abrading influences subsequent to its being the bottom of an ocean, or period of the rock formation; the river channel is also continually changing, and at times so suddenly as to change the course of the navigation. An instance of what remarkable changes take place in the face of a flat country in the

course of a century or two may be observed at or near Columbus, New Madrid, Missouri. Here are the ruins of an old French fort, erected in the seventeenth century; this fort once stood on the banks of the Mississippi, now the river is eight miles away from it, but its original course is perceptible. The water of the Illinois, in its furrowing progress, has destroyed the two upper seams of coal, but they have not departed without leaving vestiges of their existence, for in the debris of the bluffs interstratified with the earth, clay, and sand, they are distinctly to be seen, and appear as if left like drift-wood after the efflux of a flood or high tide.

The sand and gravel beds at Pekin, about seven miles above Kingston, and which run away down the country for several miles in a south-westerly direction, are said to be fifty to sixty feet deep, and no coal whatever is found. This shows the denuding currents have taken a wider range on that side of the river than they have on this; had they not been composed of pebbles, boulders, gravel and coarse sand, it might have been considered this was the original course of the river; but the fact of the presence of regular pebbles and boulders shows that such must have for a long period been exposed to a rolling motion, such as would result from the tide on a sea shore, but which is not often found in the muddy bottom of a sluggish river like the Illinois. As regards the depth to which denudation has arrived in this locality, I am of opinion that the true bed of the river is on the next solid stratum of rock below the second seam of coal. I draw this inference from the fact, that below the said seam of coal and the next bed of rock, the stratum is composed of ferruginous clays, friable substances, which from the presence of sulphur, alum, and other easily oxidizable constituents, become readily disintegrated. Now as the avowed object of this inquiry is intended more to lead to the development of the lower coal measures, than to expatiate on those now discovered, the question will naturally be asked:—That if the water currents have destroyed and entirely swept away the two upper seams of coal between the bluffs and the river, although there is one hard layer of rock below the second seam, why should they not have gone deeper, and destroyed the third and fourth seams also? In reply to such a question I would say, that a thin layer of rock (and the one below the coal is only two feet thick), however hard, might be easily broken up by expansion in freezing, or the swell of the coal seams below when relieved from the superincumbent weight of top strata. These invariably expand, as may be daily seen in the "creep" of all deep winnings; such a layer then as this of only two feet thick would readily give way, and once the water got into the crevices, it would saturate the soft friable stratum below, and the whole would be easily destroyed. But, when it comes to a stratum of hard rock from twenty to fifty feet thick, and that too situate many feet be

low the ordinary water level of the country, the tenacity of such a body would present such a vast resistance, that the common mechanical forces of natural expansion would not be sufficient to overcome it; such are the conclusions my investigation of the matter has enabled me to arrive at, and it is my opinion that beneath the thick stratum of rock all the coal seams will be found entire, but that slip dikes may occur towards the south and southwest, and must be expected, and we also may run upon some regular "faults" yet, in depth, although at the present time nothing of the kind is to be seen worthy of that name; still there are gravel and dirt banks in the upper measures hereafter described, that I have been compelled for the sake of perspicuity to call "faults," but which are not what is usually understood by that name. An inquiry into the geological features of this locality could be carried to a considerable extent, and pertinent reasons adduced for opinions herein and hereafter expressed relative to the lower measures; but for the purposes of an ordinary mine report they become unnecessary, and more particularly so, as from the bluffs northward the Kingston Estate is all of the clay prairie description, although it is covered by timber at surface, and on which but little denudation as affecting its best mineral resources have taken place. I will now proceed with a general description of the Estate.

THE ESTATE

Consists of 1,180 acres, and was a few years since all forest land, but a good deal has been cleared and rendered cultivable; its soil is of the richest quality; that near the bottoms or from the base of the bluffs to the line of flood water mark, a distance of over a quarter of a mile, is a fine dark, alluvial loam, admitting the profitable growth of every description of agricultural and horticultural produce common to the country. The surface is a gentle slope from the river, rising at a gradient of 3 1-4 in the 100, or 173 feet to the mile. On this natural esplanade is commenced the town of Kingston. A more favorable site for a town could not be chosen; standing fifty feet above the river, it commands a perfect drainage, thus rendering it, in a sanitary point of view, all that is desirable; while its easy connection with the river, and the intended railroad, makes it perfect in its mercantile position. There are at present sixty-eight dwelling-houses, of various classes, such as usually precede, in all the western countries, the progress of refinement; a commodious and well stocked store, steam saw-mill, carpenter's and smith's shops, granaries and warehouses, a small church, post-office, school, and tavern or boarding-house. The town lots have been staked out in regular streets, and all new buildings are erected in conformity therewith. At the river is a jetty or pier, coal wharves and sheds, where the river steamers call

to coal going up the country. Above the piers are spacious platforms, erected above flood water line, connected by means of a viaduct, and railways direct with both the lower and upper mines; on these are the weighing machines, screens and tips, from which the coal is loaded into the barges for exportation.

The Lafayette and Indiana, or the Bureau Valley Extension Railroad, connecting the Illinois River towns with Warsaw, on the Mississippi, or Hannibal opposite the Missouri, will pass through the town at the lower and between the first dwelling houses and the works on the river. At present the nearest connection with any public line is at Kickapoo Creek, twelve miles on the road to Peoria. The line is open from thence to Rock Island, and also to Chicago. The site for the depot and sidings for coal trucks will be near where the saw-mill stands, and the low ground between that and the river, which is about 200 yards, and covered with water in time of freshets, will become filled in every year by town refuse and waste from the mines, and form in course of time splendid building sites for warehouses, wharves and quays. The current value of the estate may be arrived at near enough for practical purposes, by apportioning it in the following manner.

69	acres	Arable Land, fenced in,	$30	$2,700 00
140	"	Land, partly cleared,	16	2,240 00
20	"	Good Meadow, "	25	500 00
88	"	Swampy, "	5	440 00
50	"	Town Lots, "	200	10,000 00
78	"	Woodlands, heavy timbered,	60	4,680 00
690	"	Woodlands, light timbered,	15	10,350 00
45	"	Do. nearly cleared, "	10	450 00
	"	Mineral Royalties,	"	" " "
*830	"	Upper Seam, at 1-2 cent per bushel,	$827	686,410 00
982	"	Second Seam, at 3-4 cent " "	1,450	1,329,900 00
		Buildings, Railways, and Wharves, Rolling Stock, Mine Openings, Implements and Machinery, Steamboat and Barges,		35,000 00
				$2,076,670 00

In the foregoing estimate the relative value of the buildings and improvements will, as a matter of course, depend on the scale of operations pursued in working the collieries, and the mineral portion in a corresponding ratio; but the prospective value of the property entirely depends on the nature of the coal in the lower measures; this however is speculative, and not admissible in the estimate of current value. I shall, therefore, treat it under the head of the Coal Measures.

THE MEASURES—THE OLD BANK, OR UPPER SEAM WORKINGS,

Consists, from the surface admeasurement, of 830 acres of coal seam, due allowance being made for the selvage. The seam is

* An acre of coal contains 4,840 square yards.

found outcropping in most of the deep ravines and along the entire south face of the bluffs. The depth at which it lies varies, the surface being very uneven. Its greatest depth is seventy-five feet; while in other places, even where it has been worked on, it is not more than ten feet. It lies 108 feet above the river level. Its thickness, near the entrance of the main drift, is four feet seven inches, but its average of coal does not exceed four feet. It is divided into two unequal parts, by the intervention of a thin stratum of plastic clay. There is no regular cleet, but it contains numerous fine joints or partings standing nearly vertical with the base of deposition. They are mostly at right angles with each other, consequently the coal works out cubical. These joints are filled in, or otherwise—are composed of very thin films of carbonate of lime and sulphuret of iron; when first broken they are quite crystalline in their structure, but on exposure a short time to the atmosphere, the iron becomes oxidized and the lime loses its transparency and turns quite an opaque white. This segregation of the coal makes it very easy to work. There is of course a large proportion of slack, which hitherto, for want of proper coking apparatus, has been thrown away as waste. This waste is run out into heaps in the mine valley. Last summer it ignited by spontaneous combustion, and has been burning ever since. It is to be hoped this waste slack from the bank, as well as that made from the screenings at the river, will all be manufactured into coke, which it will make of a good second-rate quality, and sell readily for 14 cents per bushel, and for which an immense demand will shortly be made for the use of the locomotives on all the western railways.

I have said that the seam will not average more than four feet of coal, although the diagram shows it to be 4 feet seven inches. This depreciation in quantity arises from two causes, the most important one being from what is locally called horseback (see figure 2). From whence the term is derived I do not know, but it appears to be pretty generally adopted here. A horseback is a ruptured part of the seam; the coal is split up into numerous small fragments and mixed with clay, and often parts of the slate from the roof. Generally, it only destroys the coal down as far as the centre clay seam, leaving the lower part entire; at other places it is found broken through the seam down to the floor. The diagram is one of this kind. It may be seen in the old return air course, near its junction with the first left-hand headway. The roof is very soft at this part of the bank, and differs from the ordinary limestone. The slate is in a state of total decay, and falls around the props and cap pieces; various constructions have been put upon the causes that have led to these ruptures; that they were caused subsequent to the deposition of the coal is quite evident, for the broken coal in the horseback is found as pure and compact as in any other part of the seam. I am of opin-

ion that after the coal became formed, or in other words, soon after the vegetable substances which formed the coal became bituminized, and before the superincumbent stratum became solid rock, that powerful currents of water, in the form of whirlpools or eddies, in the then sea bottom, scooped out and partially removed the ground above that now forming the roof. The coal thus relieved of its load, swelled upwards, and thus let in the water, bringing with it the clay it held in suspension, and left it mixed with the fractured coal. That the roof was never entirely removed is quite certain, for the seam, although broken into such small pieces, still retains its original volume. There is no regularity of disposition whatever in those horsebacks, but I find they are most prevalent where the weight or resistance from pressure over the coal is the least. Such an hypothesis may be somewhat strengthened perhaps by the fact that in the lower seam of coal, as far as present explorations have been carried forward, no horsebacks are found. The next item, in the diminution of the seam, is one not so readily answered as the above. A reference to the sections will show the seam to have a variable inclination—that it forms a series of undulations, but its general dip may be said to prevail north-westerly. In these risings and sinkings, the coal has been at one place pinched up as thin as three feet thick, in other places it has expanded or has never been compressed to less than five feet thick. Surface denudation I believe has something to do with this variability of thickness also. In this case of the upper seams, one thing however is quite certain, that the density of the coal in all coal fields is somewhat regulated by the depth it lies from surface, and the nature of the stratum under which it lies, or the weight there is upon it. The same thing occurs with most metallic minerals. If, therefore, we suppose that the upper surface was at one period quite or nearly level, there must have been an uniformity of pressure. On an examination of the surface at the present, we find it presenting a series of ravines, or hills and valleys; and we find that the thinnest part of the seams is under that part of the ground that has the greatest elevation, and the thickest parts near the outcrop, or where the surface is much abraded. In the face then of such facts it is but reasonable to suppose, that if the coal seams, under a certain weight, should be only three feet, they would, with nearly the whole of that weight removed, be expanded to four feet seven inches.

But there are other agencies at work beside that of natural expansion; causes arising from the internal condensation—solidification and contraction of the earth's crust; the phenomenon that sinks whole continents below the ocean tides, or elevates its lowermost depths into mountain summits, far, far up among the fleeting clouds; rending asunder sedimentary strata, thousands of feet thick, that have been forming for tens of thousands of years, or since the earth's early epoch, tilting them up edge to edge, form-

ing anti-clinal axes—or leaving one end mid-air with the other buried deep in the bowels of the earth, depths to which the power of man never has descended nor ever will descend; this is the main power that is waving the coal measures from Lasalle to Alton, like so many billows rolling along on the bosom of the broad Atlantic: still, let the cause be what it may, my province is to deal with the seams as we find them: and for this purpose I now draw your attention to matters of more immediate interest, affecting the mineral value of the property. But in doing so, I shall have to diverge a little from a direct course, in order to explain the general nature of defects in coal measures, some of which, as seen here, may otherwise have a tendency of depreciating the real value of the property without any just cause.

(To be continued.)

JOURNAL OF MINING LAWS AND REGULATIONS.

THE RIGHT TO DRAIN MINES.

A case involving the welfare of the whole mining interest, so far as relates not only to coal, iron, copper and lead in Pennsylvania, but as a precedent in the United States, is now before the Supreme Court of Pennsylvania. It was a suit brought to recover damages for draining a spring, by pumping water from an engine shaft of a mine, half a mile off. If the decision of the inferior court is sustained, all mines in Pennsylvania will be subject to suits to recover damages, whether fancied or real, for miles around.

This is the first case of the kind brought up in this country. In other countries the miner is protected by local laws, or it is plain no mining operations could be carried on. We present the points of the case at some length, owing to its unusual importance.

ABSTRACT OF PROCEEDINGS IN THE CASE OF CHARLES M. WHEATLEY V. JACOB BAUGH, IN ERROR TO THE COURT OF COMMON PLEAS, OF CHESTER CO., PENN.

Abstract of Proceedings.

Summons case issued April 15, 1854. April 19,1854, "summoned personally." April 15, 1854, narr. in case filed (prout narr.). May 4, 1854, Deft. pleads not guilty.

Jan. 8, 1855, jury empanelled.

Verdict and Judgment.

Jan. 9, 1855, jury find for plaintiff, $175 damages, and six cents costs; same day, judgment *nise* on the verdict. Judgment entered on Judgt. Doc. U. p. 280.

History of the Case.

The plaintiff was a tanner, and resided at Schuylkill Township, Chester County, a short distance from Phœnixville. He occupied, as a lessee for years,

a tan-yard, with its appurtenances, comprising about an acre of ground, from 1824 or '5 to 1858, and carried on his business during the whole of that time. Upon the property which he thus occupied, was a spring of water, which he constantly used for the purposes of his business. A valuable copper mine having been discovered on the adjacent farm of the late Judge Morris, arrangements were made for working it, in the year 1851. A shaft was sunk to some depth, and a small engine set to work to pump out the water, which interfered with the operations of the miners. In September, 1853, a larger and more powerful engine was procured, by which the amount of the water pumped up out of the mine was greatly increased. About two weeks after this new engine began to work, the tan-yard spring ceased to flow. The engine continued to work till the 18th of January following; it then stopped. Two weeks afterwards, the water of the tan-yard spring began to flow with its accustomed volume. About the 1st of February the engine started again, and about the middle of the month the water again left the spring-head. In the following June the operations of the mine were suspended, and soon after the water began to flow at the spring as formerly, and continued to do so till the time of the trial.

The shaft is about 550 feet from the spring, in a S. E. direction. The surface of the ground, at the shaft, is some fifty feet higher than at the spring, and is the highest in that immediate neighborhood. Several other mines were in operation at the same time with the Morris Mining Company, within two miles distance, on lower ground, and with deeper shafts.

The suit was brought against Mr. Wheatley, as agent of the Morris Mining Company, to recover damages for the injury which the plaintiff sustained by the loss of the water of the tan-yard spring, in his tanning business.

The defendant insisted,

1st. That no action could, under the circumstances, be maintained against him.

2d. That the owner of land through which water flows in a subterranean course, has no right or interest in it, which will enable him to maintain an action against one who, in carrying on mining operations on his own land, in the usual manner, draws away the water from the land of the first-mentioned owner; and that therefore the plaintiff was not entitled to recover.

The Court instructed the jury that the plaintiff was entitled to recover, and they found for him $175 damages. The defendant excepted to the charge of the Court, on certain points exhibited by both parties; and the question now to be decided is, whether a landed proprietor shall be allowed to work a mine on his own land below the water level, if in doing so, it becomes necessary, in pumping out the water that obstructs his operations, to drain a spring or ancient well of an adjoining proprietor. The question is one of infinite moment to the defendant, and to the whole mining interests of Pennsylvania.

POINTS ON WHICH THE COURT WAS REQUESTED TO CHARGE.

Plaintiff's Points.

1. Streams of water are intended for the use and comfort of man. Every occupier of lands has a right to the use of water which flows in the stream on his lands, without diminution or alteration.

2. Where a stream of water rises on a man's land, and flows off upon the surface, and said spring and stream of water has been occupied and used uninterruptedly for twenty-one years and upwards, for domestic, agricultural, or manufacturing purposes, the adjacent proprietor has no right to do any thing upon his own land which intercepts and cuts off the subterranean streams or trapdykes, which supply the said stream and spring.

3. If a person sinks a shaft upon his own lands for mining purposes, and pumps up large quantities of water out of the shaft, so that an ancient spring and stream of water in the adjoining lands of another proprietor, is wholly

dried up by reason of the mining operations intercepting the underground streams, which fed the said spring and stream, it is actionable.

4. It is a principle of the common law, that the proprietor of land, unless restrained by covenant or custom, has the entire dominion not only of the soil, but of the space above and below the surface, to any extent he may choose to occupy it, with this qualification to his dominion, that he must so use his own as not to injure the property, or impair any actual existing rights of another.

5. The plaintiff, and those before him, having used the spring and stream of water therefrom, in the manufacturing of leather, for more than twenty-one years, the law presumes a grant of the privilege, so as to control the adjoining owner of land in the use of his own property, in any manner that shall interfere with or defeat the grant, thus supposed to be made.

6. If the jury believe, from the evidence, that the defendant, by his mining operations on the adjoining lands, cut off underground streams, which percolated and ran into, and made the spring and stream of water used by plaintiff at and in his tan-yard, so that said stream of water was taken away, and plaintiff deprived of its beneficial use, he is entitled to recover damages commensurate with the injury he has sustained.

Defendant's Points.

1. No action lies against a manager or agent of a Company for damages done by persons working for said Company, in sinking a shaft in a mine by which damage is done to a neighboring landholder, where such damage was not necessarily incident to the work, or where it has been caused by the negligence or unskilfulness of the operatives.

2. The owner of land through which water flows in a subterranean course has no right or interest in it, which will enable him to maintain an action against one who, in carrying on mining operations on his own land in the usual manner, drains away the water from the land of the first-mentioned owner.

3. The plaintiff has shown no cause of action that will entitle him to recover in this case.

Charge of the Court.

Jacob Baugh brings this action against Charles M. Wheatley to recover damages, which he alleges he has sustained by reason of certain mining operations carried on under the management of the defendant. The connection with these works of the defendant, his apparent management and supervision of the operations, and the evidence in the cause, sufficiently identify him with the cause of complaint to sustain the action against him.

The controversy arises between these parties substantially under the following circumstances. The plaintiff for a long period of time, extending over 21 years, has used and enjoyed a certain spring and stream of water in the manufactory of leather. It was necessary, absolutely necessary for the manufacture in which he was engaged. In the year 1853, the defendant sunk a shaft for the purpose of mining, at the distance of some 500 yards from the Tannery of the plaintiff, and on the first day of September of that year he fixed an engine to pump up the water from the shaft. This engine threw up large quantities of water, which ran on the surface of the ground till it entered into the river. About the 20th of that month the spring and stream dried up, and continued dry until the engine stopped work, when in a short space of time the spring flowed again and ran in its former current, with a volume equal to that it threw out before it had been dried. Thus again when the engine worked it dried, and when the engine stopped it flowed.

The plaintiff believing that the mining operations were the cause of drying up his spring and stream, has brought this suit to recover damages, as I have

stated, and the question arises whether the defendant under the circumstances can be made to answer for the injury sustained by plaintiff, if the jury shall believe that the spring was dried by the operations of the defendant.

The views of the Court in relation to the law arising in the case, cannot be better expressed than by referring to the points made by the counsel for the plaintiff.

Here the Court read and affirmed all the points made by plaintiff's counsel; affirming the first, and disaffirming the second and third points of the defendant. See pp. 4, 5, *ante.*]

The Specifications of Error.

Assignment of errors.

1. The court erred in charging the jury, as follows: "The plaintiff believing that the mining operations were the cause of drying up his spring and stream, has brought this suit to recover damages, as I have stated, and the question arises, whether the defendant under the circumstances, can be made to answer. I am of the opinion that he can be made to answer for the injury sustained by plaintiff, if the jury shall believe that the spring was dried by the operations of the defendant."

2. The court erred in disaffirming the second point of the defendant, viz.:—

"The owner of land through which water flows in a subterranean course, has no right or interest in it which will enable him to maintain an action against one, who, in carrying on mining operations on his own land, in the usual manner, drains away the water from the land of the first-mentioned owner."

(By the court), "Disaffirmed."

3. The court erred in disaffirming the defendant's third point, viz.:

"The plaintiff has shown no cause of action which will enable him to recover in this case."

(By the court), "Disaffirmed."

(To be continued.)

COMMERCIAL ASPECT OF THE MINING INTEREST

New York, May 1855.

With regard to the exchangeable or commercial value of mining stocks, we have no improvement to report as having occurred since our notice of last month. We have an increased surplus of unemployed capital, but which, though seeking investment, does not flow into mineral stocks generally.

The mining stock Board has indeed been re-organized, and efforts are making to make the various stocks more active, but without avail. The prices quoted seem ridiculously low compared with what used to rule last year. We copy the quotations as given on Friday, the 18th May:

	offered	asked
New Jersey zinc,	$4 00	$4 75 per share
Potomac & Davies,		25
Isabella,		1 00
Howassie,	3 50	4 00
Flint steel,	2 75	
Phœnix gold,	25	37 1-2

	offered	asked
McCulloch,	37 1-2	50
Conrad,	02	15
Gold hill,	37 1-2	50
Gardiner,		2 50
Lindsay,	01	04
Deep River,		02
Vermont copper,	25	50
Corinthe,	20	62 1-2
Phœnix copper,	25	30
Wycoff,		1 1-2

The stockholders of the Phœnix Gold Company re-elected their old officers on the 1st inst. for another year. We understand a steady progress is making in working the mines of the Company. Lindsay is in irrecoverable difficulties; and will have to pass into new hands, the creditors being in possession of the mines. Mr. Charles Ely has been elected President of the Gardiner Gold Mining Company in place of Mr. Zabriskie, who retires. The directors have made a report, being their first, in which they state that from the commencement of operations over a year ago, the work on the Company's property at the mine has been steadily prosecuted without let or hindrance from monetary difficulties. They employed from 40 to 65 hands, and have sunk three shafts to the depths of seventy, fifty, and forty feet respectively, and a horizontal drift of 300 feet from shaft No. 1, has been worked. It is intended to sink shaft No. 1 to water level about 200 feet deep before commencing stoping on a large scale. No. 2 shaft will also be pushed forward. These will furnish the ore necessary for the existing machinery. The Company have made purchases of some additional tracts of land, including some islands in the rivers Rappahannock and Rappedan. The amount of capital expended is $70,000 exclusive of real estate. In a few months, the produce is expected to begin to pay with profit.

We learn that Com. Stockton has taken a large investment in the Hewie Mine in North Carolina, and had sent down there between 200 and 300 tons of machinery at a cost of $30,000 to $40,000, and intends to set several hundred men to work.

From the Rudisel Mine we learn that large quantities of ore have been raised to the surface, and that a part of the stamps are now in operation, and the remainder are in process of erection. The economical and judicious manner in which the business of this mine has been conducted, and the perseverance with which the operations have been continued, entitle it to much credit with the public.

The coal stocks continue the most active of any. Reading stock has appreciated greatly during the month. The receipts of coal by the road have been beyond all precedent, and have tasked the road to the uttermost.

We annex the monthly statement of the business of Reading Railroad for the month of April, compared with the corresponding month last year; also, the net profits for the first five months of the current year, compared with the same time last year. The net profits for the month continue to show a large increase on the increased gross receipts. The gross receipts exhibit an increase. of about 45 per cent., while the net profits show an increase of 56 per cent. The net profits for five months amount to $711,817 37—an increase of 63 per ct.

April.	1855.	1854.
Received from Coal,	$340,128 98	$236,861 91
Received from Merchandise,	32,347 88	18,169 19
Received from Travel,	29,999 49	22,720 86
Total,	$402,476 35	$277,691 96
Transportation, Roadway, Dumpage, Renewed Fund, and all charges,	171,783 18	130,313 02
Net profit for the month,	$230,693 17	$147,378 94
Net profit for previous 4 months,	481,124 20	288,274 66
Total net profit for 5 months,	$711,817 37	$435,653 60

The Cumberland coal stock has depreciated as much as the Reading has appreciated, though the Company has resumed active business and is receiving full supplies of coal. The Delaware, Lackawanna, and Western Railroad and Coal Company have also advertised for sale its bonds for $600,000 at par.

The Gold Hill Mining Company have levied by vote of the stockholders an assessment of 73 cents per share to pay off the mortgage upon its property, and to defray the cost of machinery. The amount of dividends which the directors so foolishly paid out of capital was sufficient to have prevented any debt or incumbrance. The stockholders have now to refund more than they have received.

The principal inquiry for mining stocks has been for Minnesota, which brought $185 or dividend of $15 per share. Copper Falls is held at 43 to 44. Cliff is in request at 133 without sellers. Toltec is heavy at $2, but $8 has been bid for Isle Royale.

The Phœnix Copper Company has published a statement of its finances, which does not show very favorable. It raised last year,

By assessment,	$20,837 00
By sales of land, $3,100; Copper, $851 91	3,951 91
Total,	$24,788 91
Balance from previous year,	3,684 31
Total,	$28,423 22
Expenses for the year ending March 5, 1855,	25,717 20
Cash balance,	$2,706 02
Liabilities amounting to	4,347 85
Present deficiency,	1,641 83
Assessments unpaid, $255; Land sales to be received, $875,	1,130 00
Estimated deficiency,	511 83
The personal property of the mine is valued at	9,856 65

There have been a few sales at the Mining Board; 500 shares Phœnix Gold sold at 80 per cent., and several hundred North Carolina at 87½ per cent. There is also some inquiry for Lake Superior stock, both here and at Boston. Toltec has been dealt in at 9 1-2 with little offering. The directors of the Toltec Consolidated Mining Company, have just published their second annual report. The directors hope that the time is drawing near when no further assessments will be needed. This looks as if another would at least be wanted. Seven dollars per share were paid in last year. The balance sheet shows an amount of assets of $66,398 30, and against only $35,526 62 of lia-

bilities, leaving a surplus of $30,846 68, besides barrel copper and stamp work, estimated to yield $28,400. The cash in hand is $14,758 89. The other assets are assessments due, supplies at the mine and copper on hand.

The directors of the American Mining Company have published a circular to their shareholders, and those of the Windsor, Norwich, Hudson and Sharon and Derby Mines, giving some general information. Amounts of expenditure, are somewhat vaguely stated. For instance, of the Norwich mine it is stated the floating debt is *assumed* to be not far from $70,000, and mortgage bonds $15,500. The $70,000 must be raised immediately, besides $20,000 for supplies, while the yield of copper is only sufficient to bring in $46,000. Consequently $44,000 have to be raised by an assessment.

Again, of the Windsor Mining Company, it is stated that the floating debt of the Company is assumed as being not far from $33,000, the supplies wanted will require $15,000, while the produce will only yield $12,500, leaving a sum of $35,500 to be raised by assessment.

The copper produce cannot be removed till the claims of laborers are paid and other liens discharged.

HUDSON MINING COMPANY.

Floating debt assumed,	$4,000
Sharon Mining Company, in like manner,	10,000
Derby " "	5,000

All to be paid by assessments. The assessments have commenced by a levy of

$2 00	per share	on the	Norwich
1 50	"	"	Windsor
20	"	"	Hudson
25	"	"	Sharon
25	"	"	Derby

Further ones in a short time.

JOURNAL OF GOLD MINING OPERATIONS.

SAN FRANCISCO MINT.

The first annual report of the San Francisco Branch Mint has been published, and is as follows:

No. of gold deposits	6,748	
No. silver deposits	146	
	Ozs. Dec.	
Weight of gold deposits	795,921 26	
Weight of silver deposits	43,026 90	
Value of gold deposits		$14,655,847 22
Value of silver deposits		51,601 28
Silver parted from gold deposits	48,158 67	
Gold parted from silver deposits	259 38	
Value of silver parted from gold deposits		56,030 47
Value of gold parted from silver deposits		4,825 78
Mint per centage for refining		52,280 56
Mint per centage for coinage		41,862 41
Mint charges on bars		80,218 94
No. of gold assays	20,229	
No. of silver assays	438	
Total assays	20,667	

GOLD COINAGE.

No. Pc's	Denom'n.	Value.	
317,418	Double eagles	$6,360,360 00	
123,826	Eagles	1,238,260 00	
268	Half eagles	1,340 00	
206	Quarter eagles	616 00	
14,632	Dollars	14,632 00	$7,615,297 00
456,390			

SILVER COINAGE.

29,800	Half dollars	$14,900 00	
122,000	Quarter dollars	30,500 00	
			45,400 00
151,800			
	Total gold and silver coinage		$7,660,607 00

BARS.

No. of unparted bars, 2,594		$6,428,201 90	
No. of refined bars 8		5,865 16	$6,434,065 06
	Total coinage		$14,094,672,06

The mint commenced operations April 3, 1854; the coinage of silver was commenced in March, 1855.

CALIFORNIA GOLD FIELDS.

The latest accounts from California represent increased rains and an undiminished yield of gold. Pulic attention is turning more directly to quartz mining, which must ultimately become a most important branch of mining in that State.

The necessity of a permanent supply of water is now seriously felt, and its importance realized. This is unquestionably now the first point to be secured in those extensive operations. The following extract will serve to show the views at present entertained.

WATER IN THE MINES.

From accounts gathered from various quarters, we ascertain that a much less body of snow is now lying in the mountain districts, than has been the case upon any previous year since the settlement of the State. At the present time the ground is entirely bare, in localities, where last year at this season, there was found to be snow to the depth of several feet. It is to this substance, its continual melting and dripping, that the miner looks for his supply of water late into the season, and as a matter of course, unless some unforeseen circumstances intervene, we may look for a dry time to commence at an early date. Already the effects of the last rain have disappeared, and the ditches are as low as ever. This shows the necessity which at present exists for the adopting of measures, by which a more abundant, and longer supply of this so much required, and indeed absolutely essential element, may be obtained. The mining regions must look to other and more permanent sources for their supply of waters than they have hitherto been accustomed to employ.

In the early days of the State, when comparatively few people were present within her borders, and every ravine, and all over the surface of the ground, gold was lying, scarcely hidden, the labor of the miner was easy and secure. He required no other capital than a pair of strong hands, a shovel, pick and pan, and his willingness to labor was soon rewarded with an abundance for all present necessity. But now, the whole character of mining, as an occupation, has changed, and that which would suffice in years gone by, will no

longer answer for a dependence. The gold has been sifted from the ravines, and a large portion of the rich deposit has been skimmed from the surface. The richest leads are now known to be imbedded in the mountain sides, and the impatient miner must work long, and deep, in the bowels of the earth, before he will reach the object of his desires. The real mining of California is just commencing, and every practical man can see before him, years of richly paying labor, for himself, his children, and even on to another generation.

But now, the little streams and intermittent ditches will no longer suffice for the prosecution of a successful business. To get into the diggings requires long time, severe labor, and a considerable expenditure of money, and it will not answer in the least degree, for all this to be undertaken in order to prepare for a few weeks "washing." Water is now required in abundance, and water all the time. Here rests the whole future of California success. Long enough have men labored during the few weeks of falling rain, in order to provide for the months of necessary idleness, and it is time that they should begin to enter the business in a practical manner, and in a way which shall cause their occupation to pour into their lap, the real wealth which is contained in the miner's business. The State, its people, capitalists, working men and all, must sooner or later wake to this necessity, and some concert of action, and some determined means for bringing water into the mining regions must be adopted, or else we must be forced to hear, year after year, during the majority of the months, the cry of "hard times" as the cause for continued failures and increased distress. The gold is here, and it can be obtained. The water is running in useless channels, and it can be diverted to a most profitable use. To the merchant and property holder of San Francisco, and to every class in every city, town and village of the State, this subject is of the utmost importance. Upon the mines, their success or failure, depends the prosperity or decline of every species of business throughout California, and it is worse than folly so to neglect the matter upon which hangs all our hopes. "Water in the mines" is of more importance to the State, than the Pacific railroad, the line of telegraph, the election of Senator, the failure or success of banks, or in fact than any one, or all together of the plans, or causes of excitement, which have agitated the public mind during the past year. It is the foundation for success, and will render permanent every enterprise, which must otherwise be to a greater or less degree inaccurate and uncertain. Let this be attended to, and heartily carried out, and wealth and contentment shall surround the occupants of every kind of business throughout the State; all things will move on prosperously, and those who now intend going to the Atlantic States, will remain here, and yet hear their children rejoice that they were born on California soil.

THE KERN RIVER MINES.

These newly discovered mines do not prove so rich as has been anticipated. Reliable reports from the region are to the following effect:

The river claims do not pay, and the gulches yield about $2 or $3 a day. On Greenhorn gulch, one claim, owned by four men, after about a month's preparation, yielded $3,100. This is the largest amount yet realized from any claim. The gulches are very steep, with but little dirt to wash, which can only be done during rain, owing to the precipitancy of the ground. The flats have not yet been prospected, but little is expected from them. The river has been thoroughly prospected for sixty miles above Greenhorn gulch, and for about twenty miles the "color" could be found anywhere, but above that no gold had been found.

Parties had gone there to make a thorough investigation of the district, with a view to invest capital in the locality, but they at once became convinced that there was no necessity for either mills, flumes, ditches or stores.

An immense number of individuals had been enticed to the country, who were all hurrying away as best they could. A great deal of hardship had been endured by many of them.

MINES IN THE GADSDEN PURCHASE.

A correspondent of one of the California journals, who appears to be thoroughly familiar with the country embraced within the Gadsden Purchase, recently obtained from Mexico, thus describes its mineral treasures. He is replying to another correspondent who had characterized the mines as worthless:

One of your correspondents tells you that "at the deserted rancho, San Bernardino," and "from Santa Cruz west, there are but three points at which the farmer or planter can find enough land suitable for a small location; the balance of the Purchase is a barren, deserted, dreary waste." This description of points gives us some information of the route over which he travelled, and from his own statements, I should think with his eyes shut. "The San Bernardino," he says, "is an oasis sufficiently large for a stock ranch." How large he may want a stock ranch, I am unable to say. The San Bernardino Rancho is situated upon the head-waters of the Rio Yaqui, in a valley which is five miles in width at that point; thence extending north some ten miles, and as you proceed south down the stream, it widens to the point at which the line of the New Purchase will cross;—here it must be fifteen miles in width. All this part is rich agricultural land, and is covered with a large growth of excellent grass. Soon after leaving this, you enter the valley of Agua Negra, another branch of the Rio Yaqui. A few miles south of the travelled road this valley spreads out to a wide and extensive plain, well watered, skirted by a sufficiency of timber, and equal in the fertility of its soil to the prairies of Illinois. Between this point and Santa Cruz, you cross the three branches of the Rio San Pedro. The character of the soil upon all these branches and the main stream, as you proceed north, down it, must make a favorable impression upon every man of the least acquaintance with agricultural pursuits.

The valley of the Santa Cruz, in which "California" can find but "three small locations," is a valley sixty-five miles in length, between the village of Santa Cruz and the deserted town of Tubac. The entire distance in former times has been continuous ranches, but now deserted on account of the Indians. This valley has been admired by every man who has passed through it, and hundreds would leave California to-day, to fix their residence within that valley, could they be free from the hostility of the Apaches. Whilst to the north of Santa Cruz is a valley equalled in extent and fertility by few within the State of California.

Around the old town of San Gabriel every inducement is held out to the emigrant, in the fertility of the soil, and the abundance of water and timber. Tucson and its valley are not without inducements. Arivaca, Babacomeri, Salt Lake, and various other places, are all surrounded by valleys of a greater or less extent of rich agricultural lands.

It ill becomes "California" to speak of the New Purchase as a deserted waste; for whilst I would not willingly depreciate our adopted State, yet justice compels us to admit, that in proportion to the extent of territory, the New Purchase contains three acres of agricultural land to every one within the limits of California.

In regard to the mineral wealth of that country, I do not feel inclined to speak in the same positive manner as your correspondent "California." Its mineral resources are as yet, to a great extent, undiscovered, nor can they be fully developed without the aid of a party sufficiently strong to repel the hostile attacks of the Navajo and Apache. A number of small parties have gone

into that country in search of gold, and I have yet to hear of the first party that has not been successful in finding it; but owing to the difficulty of procuring supplies, and the hostility of the Indians, have been forced to abandon the project ere they had the value of the numerous placers opened. Even your correspondent is forced to admit that gold is to be found on the head-waters of the San Pedro and the Gila. From the evidences I have seen, I am led to the conclusion that this country abounds in placers as rich as any ever opened in our own State, and which it needs but time to develop.

I do know that within less than twenty miles of Ash Spring, there are silver mines now in the possession of the Apaches, more extensive and richer than the celebrated Chihuahua mines near Corolitas.

The western end of the Purchase is known to contain mines of almost pure copper: some of the specimens I have seen in your possession would favorably compare with any specimens of copper that have ever been dug from the earth. Iron has been found in abundance around Tueson. I have seen in Tueson, an anvil made of the ore as taken from the mountain.

I have every reason to believe that when the government takes the proper steps to protect the citizens within that territory, it will be developed as one of the richest mineral countries that has yet been discovered.

THE MINTS OF THE UNITED STATES.

The subjoined article is so full of valuable details, respecting the operations in our Mints, that we have no hesitation in presenting it in these pages entire. It is from the pen of Professor ——, one of the late English Commissioners to Exhibition of Industry in this country:—

The transmissions of gold from the new State of California have caused a corresponding increase in the gold currency of the States, and have invested the Mint operations with more general interest than under the previous ordinary circumstances they possessed. The same condition of things exists in this country; and as it is intended to establish a mint in the gold producing colony of Australia, I thought it desirable to obtain as much information as I could in reference to the organization and working details of those in the United States.

The head establishment is at Philadelphia, and is called "The Mint;" there are also three "Branch Mints;" at New Orleans, in Louisiana; at Charlotte, in North Carolina; and at Dahlonega, in Georgia, respectively. The Branch Mint in California, and the Assay Office in New York, are not yet completely organized.

At the Mint in Philadelphia, gold, silver, and copper, are coined; at New Orleans, gold and silver are coined; while the branches at Charlotte and Dahlonega coin gold only. At "The Mint," the executive staff consists of a director, treasurer, chief coiner, melter and refiner, engraver, assayer, and assistant assayer. At the New Orleans Branch Mint, the staff consists of a superintendent, treasurer, melter and refiner, and coiner; and at each of the other two branch mints there are but three officers,—superintendent and treasurer (combined), assayer and coiner. The several duties of these officers, the remuneration they shall receive for their services, and the amount of security they shall give for the due performance of them, are duly prescribed by an Act of Congress supplementary to the Act, entitled "An Act establishing a Mint and regulating the Coins in the United States;" this latter Act giving all the details referring directly to the coinage of the country.

At the United States Mint at Philadelphia, the salaries are fixed as follows:—Director, $3,500; treasurer, $2,000; chief coiner, $2,000; melter and refiner, $2,000; assayer, $2,000. At the New Orleans Branch Mint the salaries are, to the superintendent, $2,500, and $2,000 each to the other officers; and at the other branch mints the superintendents receive $2,000, and the other officers $1,500 respectively. In each of the establishments, the appointment of assistants, subordinate officers and servants, is left entirely in the hands of the chief of the different departments.

In visiting the Mint at Philadelphia I had the advantage of being taken through the several departments by the chief coiner, Mr. Franklin Peale, and the melter and refiner, Professor J. C. Booth, who kindly furnished me with the following details of their operations. As the gold is brought to the Mint in various quantities and in a crude state, it passes necessarily through the department of the refiner before it reaches that of the chief coiner; I therefore give the actual details of the refining operations upon sundry deposits of gold, amounting in the aggregate to $2,000,000.

The deposits are immediately weighed and a certificate of their gross weight issued. The fires having been lighted in the five furnaces of the deposit melting room at four or five o'clock, A. M., all the deposits, amounting, perhaps, to seventy or eighty, are melted before noon; assay slips are then taken off, and the assays finished* the next morning, after which their values are calculated by the weight after melting, care being taken to include all the grains that can be procured from the flux, pots, &c., by grinding them up under a pair of small chasers, sifting, and washing. There is a clerk and his assistant and one hand wholly engaged in performing all the weighings for the treasurer, such as weighing deposits before and after melting, ingots for coinage, fine bars, and the clippings after cutting out the planchets. There are five men in the deposit melting room, two of whom attend to two furnaces each at the same time, one to one furnace and washing grains, and the remaining two are laboring assistants. The whole deposit of $2,000,000 is melted in three or four days in the deposit-room, and assayed by from the third to the seventh day.

As soon as the first deposits are assayed, say on the third day (if expedition is necessary), or always on the fourth, they are granulated in the proportion of one part of gold to two parts of silver. The pots contain 50 lbs. of gold and 100 lbs. of silver, equal to 1800 oz., and each melt requires about an hour. With four furnaces (attended by four melters and two aids), there are ordinarily made thirty-two melts per day, but when hurried forty-eight melts can be made, making from one-third of a million to one-half of a million of dollars per day. Two days' work, or about $650,000 worth of gold, equal in weight to one ton (avoirdupois weight), are granulated for a single setting with acid. The granulated metal is charged into large pots, together with pure nitric acid of 39° Beaumé, between the hours of seven and nine A. M. on the sixth day, and steamed for five hours. The pots, made in Germany, are two feet in diameter by two feet in depth, set in plain wooden vats, lined with three-sixteenth-inch sheet-lead; a single coil of copper pipe passing around the bottom of the vat blows the steam directly into the water, in which the pots are set to about half their depth.

The vats are arranged in a small house in the middle of the room with a large flue connecting with the chimney-stack, so that when in action the odor of nitrous fumes is scarcely perceptible in the building. The $2,000,000 require about sixty such pots; they are stirred about once each hour, say altogether five times, with simple wooden paddles; the next day (seventh) the acid solution of nitrate of silver is drawn off by a gold-syphon into wooden buckets, and transferred to the large vat, in which it is precipitated by salt (chloride of sodium), and fresh acid added to the metals, now containing very little silver. Steaming for five hours on the seventh day completes the refining of $650,000. Early on the eighth, one pot is drawn off, washed with a little warm water, and the gold-powder transferred to a filter. Fresh granulations are put into this empty pot, and the acid of the adjoining pot baled over upon them, and thus through the series, the whole being re-charged in from two to two and a half hours. After steaming for five hours, the acid which contained but little silver from the preceding day becomes a nearly saturated solution of nitrate of silver. By this arrangement $4\frac{1}{2}$ lbs. of nitric acid are consumed altogether for each pound of gold refined, and the latter is brought

* The mode of assaying is according to the "wet process" of Gay Lussac. This is too well known to need description here.

up to 990 a 998 m. fine,—rarely below 990. Thus every two days, 13,000 lbs. of nitric acid are used. In the course of the last year 1,000,000 lbs. of pure nitric acid, at seven cents per pound, equal to $70,000, were consumed.

The gold is washed with hot water on the filter during the eighth day, and until it is sweet, (say by 7 P. M.) The filter consists of two layers of tolerably stout coarse muslin, with thick paper between, in a tub with a false bottom, 2 1-2 feet in diameter and 2 1-2 feet deep, and mounted on wheels. One of the men remains, after washing hours, until 7 P. M., when the watchman of the parting-room continues washing the gold and silver until sweet, i. e., until the wash-water ceases to color blue litmus paper. Early on the ninth day the wet gold is pressed with a powerful hydraulic press, and the cakes then thoroughly dried on an iron pan, at a low red heat. This process saves wastage in the melting-pot, since there is no water remaining in the pressed metal to carry off gold in its steam. The same day (ninth) the gold is usually melted with a less proportion of copper than is requisite to make standard metal, and cast into bars, which are assayed by noon on the tenth. They are then melted with the proper quantity of copper, partly on the same day, partly early on the eleventh, and assayed and delivered to the coiner the same day. On the fourteenth day they are ready for delivery to the treasurer as coins.

The silver solution drawn off from the pots is precipitated in a large wooden vat of 10 feet diameter by 5 feet deep, and the chloride of silver immediately run out into large filters [6×8×14] where it is washed sweet. The filter is covered with coarse muslin, and the first turbid water thrown back; the filter, which is on wheels, is then run over to the reducing vats, and the chloride shovelled into them. There are four such vats [7×4×12] made of wood and lined with lead, one inch thick in the bottom. A large excess of granulated zinc is thrown on the moist chloride in the vats, without the addition of acid; the reduction is very violent, and when it slackens, oil of vitriol is added to remove the excess of zinc. The whole reduction occupies a few hours, and after a night's repose the solution of mixed sulphate and chloride of zinc is run off into the sewer.

About two tons of zinc per $1,000,000 of gold are employed; the silver however, in this amount, say 10 per cent. by weight, should only take, by equivalents, about 2400 lbs., so that nearly two equivalents of zinc for one equivalent of silver are used. This is found to be advantageous, as both time and space are greatly economized by this excess.

The day after the reduction the reduced silver is washed, and the second day it is pressed and dried by heat, the same hydraulic press as for gold being used, but with different drying-pans. The same silver is used again for making fresh granulations, but as it accumulates from the Californian gold, 10,000 or 20,000 ounces are now and then made into coin, great care being taken in this case to avoid getting gold in it when drawing off the silver solution, and in the press.

Such are the actual working details in refining a specified amount ($2,000,000) of gold, the first third of which is delivered as coin in fourteen days after its arrival, and the third third in eighteen days.

But as there is a bullion-fund of $5,500,000 allowed by government, depositors are paid from the third to the fifth day after an arrival, i. e., as soon as the gold is melted, assayed, and its value calculated. When two heavy arrivals occur in close succession, the time of refining and coining can be shortened from 14 to 10 days.

The number of men engaged in the refining department is 14: 1 foreman, 8 for the parting process, 3 for reducing, and 2 for pressing and drying. In the gold melting-room there are three melters and 2 assistants. The total number of hands in the melting and refining departments is 34, including a melting and parting foreman, and 8 in the place for grinding, sifting, washing, and sweeping. The last place or sweep, embraces all pots, ashes of fires, trimmings of furnaces, ashes of all wood-work, &c.

The late law for reducing the weight of silver coin necessitated an increase of force, and 15 more were in consequence employed for this purpose. While $50,000,000 in a year have been parted with the above force, they could with the same force and apparatus refine $80,000,000 if it were required.

After many experiments upon anthracite, Professor Booth stated that he had at length fully succeeded in employing it for melting both gold and silver in the same furnaces, slightly modified, in which he had been accustomed to melt with charcoal. This change had been accompanied by great economy in the cost of material and labor, and by greater comfort to the workmen, from being less exposed to heat. The cost of charcoal (of the best quality—hard pine-knot coal) is 16 cents per bushel, delivered at the Mint; and while the cost of this fuel for all their operations in 1852, when gold was chiefly refined and melted, was about $7,000, the cost of anthracite will be from $600 to $1,000. In using the anthracite, he found that a simple draft of air, without a blast, was quite sufficient to sustain combustion.

Californian gold frequently contains the alloy "iridosmine," which is not always detected by the assay. In order to remove it as far as possible without actually dissolving gold, it is allowed to subside, first in the granulating crucibles, and then in the crucibles for toughening (melting fine gold and copper). If the assayers report its presence in the toughened bars, they are again melted, and the iridosmine allowed to subside. By these three, and often four successive meltings, the gold is separated from its troublesome companion as far as practicable. The gold thus refined, and reduced to the proper standard, [*Section* 8: "And be it further enacted, that the standard for both gold and silver coins of the United States shall hereafter be such, that of 1,000 parts by weight, 900 shall be of pure metal and 100 of alloy; and the alloy of silver coins shall be of copper, and the alloy of gold coin shall be of copper and silver; provided that the silver does not exceed one half of the whole alloy,"] is delivered over to the chief coiner in the form of bars or ingots of a certain weight, to be divided and shaped into pieces required for the currency of the country.

The *Coining* department of the establishment is of a power and efficiency sufficient to perform all the mechanical processes incidental to the issue of nearly 70,000,000 of pieces during the past year; and I was assured by Mr. Franklin Peale, the chief coiner, that it could have executed much more if it had been steadily employed, or fully supplied with material during the whole of that period. It is not necessary to go through the whole course of operations in this department, but to notice only such as possess novelty or present special characteristics.

The necessary power for working the machinery is obtained from a large steam-engine of the form usually known as the steeple-engine; it is a double vertical high-pressure engine, with cranks at right angles, the power being carried off by a caoutchouc belt, 2 feet wide, from a drum of 8 feet in diameter; the estimated power is equal to 90 horses. At times, this is all required, at others much less is sufficient, and in uncertain proportions; to meet this irregularity, and to ensure that steadiness of motion so necessary in such delicate operations, a governor and throttle-valve of a peculiar construction have been devised, which have now been in use for some time, and have produced most satisfactory results, fully effecting the purpose for which they were designed. The rolling mills, four in number, are driven by belts, at the rate of six revolutions per minute; the distances between the rollers being adjusted by double wedges, moved by a train of wheels which are connected with a dialplate and bands, divided and numbered into hours and minutes, so as to indicate the proper thickness of the strips of metal without the use of gauges. Gold strips are heated in an iron heater by steam, and waxed with a cloth dipped in melted wax, and the silver strips are coated with tallow by means of a brush. The draw bench is used for both metals, and trial pieces are cut

from every strip and their weight tested, preparatory to the cutting of the whole.

The cutting processes are very simple and efficient, consisting of a shaft moved by pulleys, and a 2 1-2 inch belt, with a fly-wheel of small diameter but sufficient in momentum to drive the punch through the slip of metal by means of an eccentric of 3-8 inch, at the rate of 250 pieces per minute, which skilled hands can readily accomplish and continue until the slip is exhausted. The annealing during the rolling of the ingots into slips is performed in copper cases, in muffles of fire-clay and brick, heated by anthracite coal, three muffles or hearths being kept at a bright red heat by one fire-grate or furnace, and the distribution and intensity regulated by dampers. These annealing furnaces are recent in their construction and very satisfactory in operation; they are heated by anthracite at the cost of about one fourth the expense of the wood previously employed.

The whitening of planchets is performed as usual by inclosing the gold in luted boxes, and by exposing the silver in an open pan, to the heat of a simple furnace with wood fuel; the drying and sifting after the action of dilute sulphuric acid, is rapidly and effectually accomplished by a rolling screen—one portion of which consisting of a pair of closed concentric cylinders, between which high-pressure steam is admitted. The blanks, with a sufficient quantity of light wood saw-dust (linden or bass wood is the best), being introduced into the interior cylinder, a revolving motion is given to it by the engine for a certain time; the door is then opened and the blanks and saw-dust gradually find their way into the wire screen, by which they are separated, the movement being continued until the separation is complete, when the blanks are discharged at the end of the machine. An arrangement exists by which a slight inclination is given to the machine so as to direct the motion of the blanks towards the discharging end.

The milling machines are, I was informed, peculiar to this mint, and are in a great measure original, the operation being performed by a continuous rotary motion, with great rapidity and perfect efficiency, varying in rate according to the denomination of the coin, between 200 and 800 pieces per minute, and at the same time separating any pieces that are notably imperfect.

It must be understood that the operation here termed "milling," is merely for the purpose of thickening and preparing the edge, so as to give a better and more protective border to the coin, the ornament or reed, commonly known I believe in this country as "milling," being given to the piece by the reeded collar of the die in which the piece is struck.

The coining presses, 10 in number, and milling machines are worked by a high-pressure horizontal steam-engine, made from the design and under the direction of the present chief coiner, in the workshops of the establishment, in 1838.

The presses are three sizes, the largest applicable to the striking of silver dollars and double eagles:—the second to pieces of medium value:—and the smallest to the dime, half dime, and three cent pieces. The first is usually run at the rate of 80 per minute, the last at 104 per minute,—the average rate of the whole is 82 per minute. This rate can be increased if required.

If all the presses were employed in coinage at the usual rate, they would strike in one day (9 working hours) 439,560 pieces; and if employed upon gold, silver, and copper, in the usual manner, and on the usual denomination of coin, they would amount in value to $966,198.

During the past year, on one occasion, 8 of the presses were run 22 out of 24 consecutive hours, and coined in that time 814,000 pieces of different denominations of coin.

These presses have been made principally in the workshops of the Mint. They possess, in common with the presses of Uhlborn, in Germany, and Thouellier, in Paris, the advantage of "the progression lever," "le genou" or "toggle joint," a mechanical power admirably adapted to this operation; but

in almost every other particular they are original in arrangement, being the result of experience, beginning as far back as 1836.

In order to supply these presses, various means have been devised; among them, and not the least important, is the "shaking box," in which advantage is taken of a disposition observable in similar bodies, or bodies of similar form, to arrange themselves in similar positions. This is a box, whose bottom is constructed with parallel grooves adapted to the size of the blanks of planchets to be arranged. A quantity of them is thrown indiscriminately into the box, which is then quickly shaken in the direction of the grooves, the pieces immediately lay themselves side by side, in parallel rows, from which they can easily be lifted in rouleaux as required to be passed to the feeding tubes of the mills or presses.

It is very evident to all visiting the establishment, that such a large number of pieces could not be coined and manipulated by such a limited number of hands without the aid of some labor-facilitating arrangements, one of the most worthy of remark of which is, the method of counting the pieces coined—if counting it can be called, for in principle it is a measuring machine. The arrangement of this counting frame, or tray, may be understood from the following sketch of its construction:

A board or tray of such dimensions as may be required, is divided by a given number of parallel metallic plates dissected into its plane and slightly elevated above it, the edges of which rise no higher than the thickness of the coin for which it is intended. The board is of such a length as will admit of a few more than the required number of pieces to be laid longitudinally in the rows, and is divided across and at right angles with the rows, and hinged at a point opposite to a given number. One of those employed by this department, counted 1,000 pieces, that is to say, it had 25 parallel grooves or rows sufficiently long to receive 45 pieces. Now, having thrown on this board a large excess of pieces, it is agitated by shaking until all the grooves are filled, and then inclined forwards until all the surplus pieces have slid off, one layer only being retained by the metallic ledge; the hinged division is then suffered to fall, which at once throws off all but the 45 pieces in the length of each row. This operation, somewhat difficult and tedious to describe, is performed in a few seconds, and results in retaining on the board 1,000 pieces, each piece exposed to inspection, and the whole accurately counted without the wearisome attention—so likely to result in error—required under usual circumstances.

The very large number of pieces coined during the last year has been counted exclusively by two female manipulators, assisted by a man who had the duty of weighing them in addition as a testing check. The same amount of labor by ordinary means could not have been performed with fewer than thirty or forty hands, to say nothing of inferior accuracy. This machine was originally arranged and patented by the late R. Tyler, coiner of the New Orleans Branch Mint, but materially improved in its application and construction by Mr. Franklin Peale.

The balances of the Mint of the United States have received the attention necessary to an instrument of such importance in mint operations. They have been arranged and made generally in the workshops of the establishment, and operate entirely to the satisfaction of the department. It is not necessary to enter into details of their construction, as a full and minute description is given in the *Journal of the Franklin Institute* for July, 1847. I, perhaps, ought to mention that since that appeared, some slight improvements have been made by inclosing all but the stirrups and pans in glass, by these means excluding dust and protecting them from the influence of air currents.

In concluding this brief sketch of the practical working of the two most important departments of the United States Mint, I cannot omit a reference to the very excellent remarks of the chief coiner on the employment of females in some of the operations in his department. This, he informed me,

had generally excited the surprise of, and had been commented upon, by foreigners, who had visited the Mint. His experience, however, had led him to believe, that in places of trust, where no great physical exertion was called for, but where accuracy and strict integrity were of first importance, the moral perceptions of the female, generally stronger and of a higher standard than in the man, would qualify her as his substitute, and thus, while opening a new field of labor for the occupation of females, would strengthen their claims to it by the superior accuracy and economy of their work.

JOURNAL OF COPPER MINING OPERATIONS.

LAKE SUPERIOR REGION.

The anticipations for the summer are of a very flattering character in the Lake Superior region. The substantial mines promise a greater yield of copper than during any previous year. At the same time the facilities offered by the completion of the canal around the Falls must have a very manifest effect throughout the entire region. We annex several items indicative of the state of operations during the Spring:

Adventure Mine.—The Adventure Mine has worked during the month of March by tribute. The expense was $32.18, and the proceeds amounted to $160.75; leaving a balance of $128.62; which, divided between the two men who worked it, gives $64.31 each, which are good wages in these hard times.

Minnesota Mine.—The Minnesota Mine raised during the month of March, 115 *tons* of copper; and during the same month the Rockland raised 11 1-2 tons. At the Rockland it is determined to erect stamps during the summer, when the whole produce of the mine will be made available and taken to market.

Portage Lake Mines.—Several of the new mines stopped a while on account of the money pressure, but those which are operating look remarkably well. The Isle Royale has a large quantity ready to ship, and is producing more for the amount of the expense and labor than any other mine. The Portage mine has a large quantity raised but cannot ship any till the new stamp works are erected. Its prospects are very fair, and it will soon pay after the proper machinery is erected, and the first heavy expenses met. The Quincy, Pewabic, and one or two other new mines, are well spoken of.

Isle Royale Mining Company.—Information has been received from the Isle Royale mine that the company has shipped this spring 101 tons, 908 lbs. of copper, as follows:

Masses	15 bbls.	6,114 lbs.
Barrel work . . .	167 bbls.	89,683 lbs.
Stamp work	193 bbls.	107,131 lbs.
Total		202,908 lbs.

The yield for the month of April was 26 tons. The Company has only 16 heads of stamps running, but will add in the course of the season 16 more, when the yield can be little if any short of 40 tons per month.

National Mine.—The National mine has got out some small masses of copper, and for the force employed, have during April raised 1 1-4 tons to a man, making in all about 10 tons of copper.

The Toltec Mining Company.—The annual report of the Directors, Treasurer, and Superintendent of this company has just been issued. From them

we learn that 225 fathoms of ground have been stoped, at an average yield of 497 lbs. of rough copper (say 60 per cent. of pure metal) to the fathom. In February last a mass weighing 53,300 lbs. was taken out from the depth of 180 feet. Masses of various sizes are now visible in different parts of the mine. The vein is improving, also, in the richness of its stamp stuff and the abundance of its barrel work. 3,000 tons of stamp stuff, estimated to average three per cent. of copper at least, are at the surface; 32 heads of stamps are in actual operation. When the shafts are connected at the third level, say 200 feet below the surface, there will be 5,000 fathoms of stoping ground which will require the constant labor of 100 miners eighteen months. At present there are 3,100 fathoms ready for stoping. Copper of the value of $10,000 is ready for shipment. Setting aside the supplies on hand (estimated to be worth $24,203 43, and estimating the amount that will be due for labor, the mine will stand clear of debt on the 1st of June, 1855, and with a balance of cash in its treasury of about $6,500.

ROCKLAND MINE.

The Report of the Directors of the Rockland Mining Company was made on the 18th of April. From this we gather the following important particulars relative to their mine and operations:

The Rockland Mining Company was formed by Articles of Association entered into on the 27th of September, 1853, under the General Mining Law of the State of Michigan approved February 5, 1853, with a capital stock of 500,000 dollars, in 20,000 shares of 25 dollars each; and was fully organized as a corporate body at the first meeting of stockholders, called pursuant to the provisions of said Act, and held on Thursday, the 13th day of October in the same year, when a Board of seven Directors was elected, By-Laws adopted, and an Assessment of One Dollar per share levied upon the stock, subject to the call of the Directors. And at a meeting of the Board of Directors held subsequently on the same day, a President, Secretary, and Treasurer were elected—an Office located in this city—an Agent appointed to superintend their mining operations, and an instalment of 25 cents per share called in on account of the assessment levied the same day by the vote of the stockholders.

The Company thus formed was designed to be located upon and work a certain tract of mineral land forming part of the original location of the Minnesota Mining Company, but subsequently conveyed by said Company to the "Lake Superior Mining Company of Eagle River," and by the latter set off and appropriated for the location of the said Rockland Mining Company, when it should have been fully organized, and certain prescribed conditions complied with on their part. The estimated value of the said mineral tract was 100,000 dollars; and one of the conditions of said conveyance was, that the 20,000 shares of the capital stock of said Rockland Mining Company should be assigned to, and divided *pro rata* among the stockholders of the said "Lake Superior Mining Company of Eagle River;" and that the estimated value of the said location, to wit, 100,000 dollars, should be considered and acknowledged as so much actually paid in on the capital stock of said Company by the original stockholders, so that the said shares, when issued, would each represent five dollars of paid up capital.

The Rockland Mining Company therefore, being thus formed and fully organized as above stated, and having complied with all the conditions stipulated by the said "Lake Superior Mining Company of Eagle River," received from the latter a deed of conveyance of the following lands, situated in Township 50 North, of Range 39 West, in the county of Ontonagon, in the State of Michigan, to wit: the south-east quarter of section 10, the south-west quarter of section 14, and the north-east quarter of section 15; comprising in

all 480 acres. Said deed bears date May 13th, 1854, and is duly recorded in the Register's Office, of the County of Ontonagon aforesaid.

The tract in question immediately adjoins the eastern line of the Minnesota Company's lands, and appears to carry across its whole breadth (some 3,000 feet) a continuation of the mineral veins which that Company is so successfully working. Indeed, the Lake Superior Company had already made explorations thereon themselves, and opened to some extent the ancient pits or diggings on the three principal parallel veins. The show of mineral in these openings was so encouraging, and the general indications on the line of surface veins so satisfactory, and so analogous to those of the Minnesota tract, that the Board of Directors resolved to commence their mining operations at that point, under the direction of their experienced agent, Mr. Roberts.

Before, however, any work of consequence could be done in the mining department, buildings had to be erected, and necessary accommodation provided for the workmen to be employed. Immediate measures were therefore taken to procure building materials and other requisites, in readiness for the ensuing spring; and in the mean time a few men only were kept during the winter at sinking the shaft, temporary accommodation having been afforded them by the assistance of the Minnesota Company. By the opening of last spring, considerable progress had been made in the mining work, and in erecting buildings to accommodate a larger force. Some copper also had been taken out, and the prospects of the mine were highly satisfactory, continuing steadily to improve during the ensuing summer, and realizing most favorable results in the production of copper during the fall and winter.

The following report from Mr. Roberts, gives full particulars of the plan adopted for opening the mine, the progress made therein, the actual results up to the 1st January last, and his estimate of the prospects for the present year:

"The mineral range extending east of the Minnesota mine, and on which the Rockland mine is situated, rises from 40 to 50 feet above the surface of the former, the bluff affording an opportunity for drainage on the north side, and of proving the vein to the depth of 160 to 170 feet by an adit. The valley on that side affording also abundant water for stamps, conveniences for building, &c., and being more accessible for teaming, an adit was commenced in 1853 at the lowest point in the valley, to drive south. This adit, at a distance of 390 feet, cut the north vein at a depth of 170 feet; continued south, it cuts the main vein at about the same depth, at a distance of 180 feet, and can be continued further south a distance of about 100 feet, and cut the vein next to the conglomerate—called at the Minnesota mine the "south lode" or vein.

"Three shafts have been sunk, numbered 1, 2 and 3—Nos. 1 and 2 to the depth of 170 feet each, and No. 3 about 70 feet. Two levels have also been run, the first at a depth of 90 feet, 420 feet long; the second at a depth of 170 feet, 412 feet long, and connecting with the adit, affording drainage for the whole mine to that depth. There is also laid in the adit and second level a good tram-road, which conveys most of the rock from the mine, and will also carry the mineral and stamp-work from the mine to connect with the road to the stamp-mill.

"The extent of ground opened so far, is as follows: shafts, 410 feet; drifts, 832 feet; adit level, 390 feet; cross-cut to main vein, 180 feet. The main vein has recently been cut, and has all the characteristics of the Minnesota vein. A portion of the ground has also been stoped, producing for the past year 40 tons of mass and barrel copper, and about 400 tons of stamp-work. The extent of ground opened, the appearance of the veins exposed, and the accumulation of mineral now on the surface, warrant and require the erection of an engine for stamping machinery as early as practicable. The stamp-work being thus made available, it will be safe to estimate the production of the mine for the ensuing year, at 75 to 100 tons.

"The buildings erected, the surface improvements already made, the personal property on hand at the mine, and their cost, are as follows:

1 large boarding house and 4 smaller ones, to accommodate 80 men	$3,500 00
2 horse whims, for hoisting from the shafts, with ropes, chains, shaft-houses, &c.	3,000 00
Blacksmith's shop, barn, and other out-houses, with roads and clearings, &c.	2,000 00
Oxen, horses, sleds, carts, harness, &c.	750 00
	$9,250 00

"We have at present in the employ of the Company 35 miners, 2 blacksmiths, 2 carpenters, and 22 laborers and others—in all, 62 men—making, with 20 women and children, a total population of 82 persons resident at the mine."

The following extracts also from the subsequent monthly reports for February and March, bring down our information to nearly the present time, and show the continued progress of the work to be in the highest degree satisfactory:

"FEBRUARY.—Captain Jennings is prosecuting the work with a great deal of judgment, interest, and energy—and it is now evident that the *Rockland* is destined to be one of the first mines on Lake Superior. The principal vein is still improving as the drifts are extended eastward. Last month we raised a solid mass of 3,000 lbs., one of 1,000 and several smaller ones, besides a large quantity of excellent stamp-work. We have a fair vein exposed in both levels, with more masses in sight. The cross-cut south to the Minnesota vein is now in 80 feet, and we expect to reach it next month. If we had stamps in operation to enable us to dress the stamp-work, I think we could *even now* send off nearly copper enough to pay our mining expenses. They should be erected as early in the season as practicable, in order to make the whole product of the mine available at the earliest period.

"MARCH.—We have raised some nine or ten tons more of copper since last report, which will be weighed off when properly cleaned of rock, &c. There is also considerable barrel copper among the stamp-work, which can be made available at once by burning in a kiln, and this we are preparing to do. The cross-cut to Minnesota vein is now in 128 feet, and we are at work in a *large and rich vein*, producing lumps from 50 to 60 pounds weight, and resembling the Minnesota vein in every feature except the dip. We have now as many men employed as can work at this point, and shall open on the vein as fast as possible. Our expenses for the last two months have been high; but we are now making material reductions, which the present situation of things in the country will enable us to effect without reducing our working force, or impairing its efficiency."

To meet the expenditures incurred in opening the mine to such an extent, your Directors on the 29th June last called in 50 cents more per share on account of the assessment originally levied (making only 75 cents in all) believing that the yield of copper for the summer and fall, from the promising appearance of the works at that time would suffice to supply the additional means that might be required to the close of the year. This expectation was very nearly realized, as will subsequently appear;—but in the mean time the work had progressed so rapidly, and the development of the mine was pushed on by our agent and mining captain with so much energy and success, that it became evident we should require the erection of more buildings and machinery by the ensuing (present) spring—and as the Directors had only 25 cents of the original assessment left subject to their call, it was hardly worth while to call in so small an amount, your Directors preferring to await this Annual Meeting, when a full report should be made to the stockholders of the value and prospects of their property, and sufficient assessments asked for to procure the requisite machinery, and carry on the Company's enlarged and constantly enlarging operations. It is true, in taking this course we were obliged to incur a large temporary indebtedness, as our accounts will show; but the work has not suffered in consequence and is now in a position which must ensure the cheerful and ready assent of the stockholders to such assessments as may be necessary to meet the present and prospective wants of the Company. Your Directors would therefore suggest the propriety of levying an assessment of two dollars per share on the capital stock, subject to their call as may be required—although they hope that the increasing yield of copper the ensuing season will render it unnecessary for them to call for the *whole* of it this year. But in the long interval of twelve months between the Annual Meetings, the Directors should be provided against all contingencies as regards the finances of the Company, and the means for carrying on its operations and sustaining its credit. It is indeed not improbable, that our present indebtedness being discharged and stamping machinery provided, the mine will nearly or quite pay its own expenses from the estimated yield of 75 to 100 tons of copper the

present year—in which case we may fairly hope that further assessments will thenceforth be unnecessary.

The quantity of mineral shipped from the mine up to the close of navigation last fall was—80 masses, 31,952 lbs. and 24 barrels, 14,106 lbs.—total, 46,058 lbs., producing 34,554 lbs. pure copper, being a yield of something over 75 per cent.—and the sales of which realized the sum of $8,824 91. This is believed to be the largest product, *for the first year*, from any mine yet opened on Lake Superior.

A summary of the accounts herewith submitted, will show the receipts and expenditures of the Company, its financial condition on the first May ensuing, and the amount required to meet our then indebtedness. Your Directors have already authorized the purchase of the stamping engine and necessary machinery which are now imperatively required, and which will cost about $7,000 to $8,000.

Abstract of Treasurer's Account.

To Assessment of November 1853 collected, at 25 cents per share .	$5,000 00
" " July, 1854, do. " 50 " " .	10,000 00
" Sales of copper received from the mine, 1854	8,824 91
	$23,824 91
By payments made on account of the Company, as per cash-account and vouchers	23,451 99
Balance in Treasurer's hands	$372 92

Statement of Expenditures and Indebtedness.

To amount of expenditures from commencement of work in 1853, to January 1st, 1854	$7,860 84
To amount of expenditures from January 1st, 1854, to January 1st, 1855	27,999 71
" " " for January and February, 1855 .	6,097 42
" " " for March and April " estimated at	6,000 00
	$47,957 97
Less, amount paid on account of the above, as per Treasurer's vouchers	23,451 99
Amount of indebtedness May 1st, 1855 . . .	$24,505 98

Resources.

Cash balance in Treasurer's hands . . .	$372 92
Mineral on hand at the mine (80 tons), estimated net value in copper	10,000 00
400 tons of stamp-work, estimated net value in copper	8,000 00
	$18,372 92

The above assets (except cash balance) are of course not available at present; but with the further production to be realized the present season, will doubtless carry on the work up to October or November next, besides providing for the machinery already ordered. It will therefore only be necessary *now* to provide for the indebtedness of the Company up to the 1st May ensuing, as stated above—and for which an assessment of $1.25 per share will be sufficient.

We may also remark, with regard to our expenditures, that a considerable proportion of the amount (nearly $10,000, as stated in Mr. Roberts' Report) is represented by buildings and other permanent improvements, together with cattle, tools, and other personal property at the mine, all fully worth their cost for the present and future business purposes of the Company.

COPPER FALLS MINING.

The Annual Report of the Directors, Superintendent and Clerk of this mine was made April 2d. Very full extracts from the Report of the previous year, relative to indications, were made a year since, in the pages of this Magazine; we shall therefore, at this time, only notice so much of the present Report as shows the amount of work done, and the financial condition of the Company.

Mine work, from March 1st, 1854, to February 1st, 1855:

HILL MINE.

1971 feet 5 inches drifted	11,656 00	
285 " 11 " shaft sunk	4,638 81	
65 " 8 " winze sunk	580 16	
568 14-36 fathoms stoped	8,278 04	
		$25,148 01

COPPER FALLS MINE.

1149 feet 9 inches drifted	7,684 12	
191 " 7 " shaft sunk	3,444 24	
128 " 9 " winze "	1,416 32	
486 17-36 fathoms stoped	6,457 09	
		$19,001 77

OWL CREEK MINE.

885 feet 8 inches drifted	3,143 16	
129 " 6 " shafts sunk	1,998 50	
		$5,141 66

BIGELOW MINE.

209 feet 9 inches drifted	848 94	
20 " sinking shaft	120 05	
		$968 99
Total mining expense		$50,260 43

By the above figures, which I have presented, you will perceive that we have opened our mines by

Drifting	4,157 7-12 feet
Sinking	821 5-12 "

and have stoped 999 31-36 fathoms—at the following average cost, including powder, fuse, &c., and timber-work:

Drifting and cross-cutting per foot, about	$5 61
Sinking shaft and winze, " "	14 85
Stoping, per fathom	14 73

Average number of miners employed, 96; present number, 62. Average monthly earnings, $45.13 each; less board and physician's fees, $34.63.

SURFACE EXPENDITURE.

Average force employed, 112 men; present force, 106. Average earnings, $36.39; less board and doctor's fees, $25.89 clear.

Total of surface expenses, $44,848.62.

The present surface force embraces the following occupations, viz.:—

2 mining captains, 1 surface captain, 2 engineers, 2 firemen, 4 sawyers, 5

lumbermen, 3 teamsters, 3 blacksmiths, 4 carpenters, 1 cooper, 10 wood-choppers, 2 rail-makers, 2 shingle-makers, 1 hostler, 2 laborers, 6 trammers, 11 wheelers, 6 bucket-fillers, 6 landers, 6 whim-drivers, 10 copper-pickers and rock-breakers, 2 windlass-men, 4 men and 11 boys in stamp mill and dressing-house.

This surface expenditure includes the expense of grading a fraction over two miles of roads, clearing and underbrushing one hundred and thirty-six and a half acres of land, quarrying stone, and building powder-magazine, completion of our stamping and dressing houses, and apparatus for the same, and the erection of thirteen log and frame houses.

Of materials on hand, we have over four hundred and forty thousand feet of lumber, seventy-two thousand shingles, nine thousand bushels of charcoal, and five hundred cords of wood.

COPPER SHIPPED.

On hand March 1st, 1854, at Lake	12,655 lbs.
Mass copper	46,089 "
Barrel work	63,202 "
No. 1 stamp work	27,981 "
No. 2 " "	84,319 "
No. 3 " "	48,487 "
Total shipment	282,733 lbs.

Of this, probably the last shipment, of about 11 tons, was not forwarded further than Sault St. Marie, owing to the lateness of the season.

COPPER AT EAGLE HARBOR.

No. 1 stamp work	6,799 lbs.
No. 2 " "	40,518 "
No. 3 " "	12,345 "
Total weight of copper at Lake	59,662 lbs.

FINANCES.

Liabilities.

Amount due to employees	21,100 25	
" Bills payable	1,533 63	
		$22,633 88

Assets.

Amount Cash on hand	6,056 46	
" Bills receivable	1,356 91	
" Supplies on hand	17,171 79	
" Buildings, building materials, miners', carpenters', blacksmiths', and other tools; oxen, horses, harnesses, and vehicles; steam engine, saw-mill, and other machinery; roads, bridges, and cleared land; sundry fixtures, implements, and stock, peculiar to a mining location, as per inventory on file in office	65,753 20	
		$90,338 36

Dr. *Copper Falls Mining Company, in account with Horatio Bigelow, Treasurer.* *Cr.*

1854. April 3.	To balance of old account,		29,562 89
1855. April 2.	Paid for following accounts, viz.:		
	Mining Agent's Account— paid for work at mine,		86,179 23
	Supply Account— paid for supplies sent to mine,		41,355 45
	Machinery— paid for stamp heads, castings, &c.		7,328 59
	Notes Payable— paid same,		61,642 49
	Copper— paid freight on, and smelting of year's product,		3,709 16
	Discount and Interest— paid same on money borrowed and notes receivable discounted, and allowed on 12th assessment prepaid,		4,858 96
	Insurance Account— paid premium note,		953 32
	Michigan State Taxes— paid State of Michigan 1 per cent. on capital paid in, April, 1854,		785 76
	Miscellaneous— paid office rent, printing, advertising, stationery, &c.		776 70
	Treasurer's salary— paid same one year,		1,000,00
			$238,152 55
1855. April 2	Balance old account,	1,760 34	

1855. April 2.	By Cash from following sources, viz.:		
	Assessments— from same during year, 11th and 12th,	109,760	
	from same on account 13th, due April 16th,	1,076	110,836 00
	Notes Payable— money borrowed,		87,972 73
	Mining Agent's Account— freight refunded,		760 73
	Copper— from sales of 184,189 lbs., (67.0695 tons,) ingot copper, at 27¼,		36,822 75
	Balance to new account,		1,760 34
			$238,152 55

E. E.

Boston, April 2, 1855.

HORATIO BIGELOW, TREASURER.

BRUCE MINE, LAKE HURON.

There are some 12 or more shafts now open, one of which has reached a depth of 55 fathoms, or 330 feet. The principal vein is 15 feet in width, and pretty well defined. The product is an ore of copper, there being no native or mass copper in that region. The average yield, after crushing and washing, is about 15 per cent. It is now eight years since the first opening, during which time there has been a vast expenditure in costly smelting works and needless buildings, and in the importation of useless machinery. But that day of extravagance seems to have past by, and the mine, under the present experienced captain, is managed with rigid economy and better success. He has now at work about 200 miners—all from the old country. Some of the ores are very beautiful to the eye, resembling fine gold. After being taken out of the shaft, they are taken upon a rail track to the crushing-house, where they are passed between large iron rollers, and sifted till only a fine powder remains; from thence to the "jigger works," where they are shaken in water till much of the earthy matter is washed away, after which it is piled in the yard ready for shipment, having more the appearance of mud than of copper. It is now all shipped to Swansea, in Wales, for smelting. Last year 1,500 tons were shipped to Baltimore and Buffalo, to be smelted.—*Lake Superior Jour.*

SOUTH-WESTERN VIRGINIA.

An address on the mineral wealth of South-western Virgina was recently delivered in Richmond, by Mr. W. H. Cook; some particulars which were stated therein we find in the Richmond Examiner, thus reported. They are certainly astonishing statements.

Mr. Cook first alluded to the wonderful mineral resources of South-western Virginia, describing them as of immense value and importance, even before the late marvellous discoveries. He then entered into a brief statistical account f the production and manufacture of *copper* throughout the world, in the course of which he detailed the condition of the trade of our country in that article. We confess we were not prepared to learn that the United States annually pay to foreign countries more than *three millions of dollars* for this article. Yet, that such is the fact, was demonstrated from official statistics.

From this branch of the subject, the speaker proceeded to demonstrate that the State of Virginia is capable of controlling the copper trade of the world. Recent discoveries of vastly extensive and valuable mines of copper have been made in the counties of Carroll, Grayson, and Floyd—chiefly in the first-named county. In regard to these deposits Mr. Cook's statements were absolutely astounding. It required all our confidence in his sagacity and fidelity to truth to secure our credence to his assertions. He certainly used large words when he declared that Carroll county alone could, with a reasonable development of her capabilities, annually furnish one hundred thousand tons of *copper ore*, worth *ten millions of dollars*. But the facts which Mr. Cook detailed satisfied us that he did not over-estimate the resources of his county; or that if he is above the mark, the mistake is one into which he might fall without any impeachment of his judgment and sagacity.

Many of the mines are already open. Several companies are going ahead with wonderful energy and success, and hundreds of tons of this valuable mineral have already been forwarded to Baltimore and New York, where it commands the highest market prices. Many other mines are about to be opened, and the operations will be carried on upon a great scale. In short, the supply is boundless, and the quality of the mineral is excellent.

Mr. Cook had two practical objects in view in this address. The first was to induce the people of Richmond and other cities of Eastern Virginia to en-

gage in the manufacture of copper. He does not think that South-western Virginia possesses supplies of coal suitable in quality and quantity for this purpose, whilst that article is abundant in the neighborhood of Richmond and Petersburg, and can easily be procured at other cities of Eastern Virginia. He is unwilling to see the whole of this vast quantity of a valuable raw material for manufacturing purposes transported to the North and to foreign countries to be wrought up. The copper manufacture of the United States is carried on to a very limited extent, and Eastern Virginia is peculiarly well situated to engage in the business.

His second object was to induce the tide-water cities to unite in an effort to extend facilities for transportation into the midst of those vast mines, either by constructing an arm of the Virginia and Tennessee, or by the extension of the Richmond and Danville Railroad into South-western Virginia. Whether the cities of the lowland enter into the manufacture of the article, or only desire to participate in the heavy and profitable trade which must grow out of the transportation and handling of the article, it is essential that they should bring themselves into speedy and direct communication with the mines, and this only can be effected by a zealous and united effort on their part.

JOURNAL OF SILVER AND LEAD MINING OPERATIONS.

THE WHEATLEY MINING COMPANY.

The Report of the Directors of the Company furnishes the following interesting statement:—

The development of the Wheatley Mine is the result of private enterprise. A few gentlemen of the cities of New York and Philadelphia, with Charles M. Wheatley, Esq., as Superintendent, convinced of the geological evidences of the wealth, not only of the mineral district in which the mine is located, but also of this particular vein, determined to prove its resources. This mine, therefore, has not attracted the attention of the public, nor has the stock been offered in market for sale.

Owing to the success of the undertaking, the owners have been lately organized into a corporate body, under the general Act of the State of Pennsylvania relating to mining. The individual liability of the stockholders is now limited to the few cases pointed out in the act, such as debts due to miners and laborers, and for machinery, provisions and merchandise furnished to the Company.

The mine is situated near Phœnixville, Chester County, Pennsylvania, and about twenty-seven miles from Philadelphia. The cars of the Reading Railroad Company pass within two miles of it. The mineral right owned by the Company comprises about 270 acres of land, on which there are three or four mineral lodes. The Wheatley mine, which is the main lode, is the only one which has been fully explored.

The statement now rendered was furnished by the Manager and Captain of the mine in September, 1854, and is brought forward only to the first of that month.

The working of the mine was begun in the early part of the year 1851, with a small pumping engine of about fifty horse power. At the present time the engine-shaft has been sunk fifty fathoms from the surface, or 300 feet. The adit level is driven on the course of the lode 1825 feet, the ten fathom level 1250 feet, the thirty fathom level 477 feet, and the forty fathom level 107 feet; including the branches on the lode, the whole number of feet driven

is over 4000. The lode in the forty fathom level varies from two to four feet in width, and at this point is within six feet of the shaft.

The whole amount of silver-lead ore raised is 1800 tons, of this there was raised in 1851 only 11 tons.

There are 278 paying mines in England, Ireland, Scotland, Wales, and the Isle of Man. The average yield of these mines is 376 tons each mine of 62 per cent. ore; only 20 of them sold over 1000 tons of ore in one year, and only seven over 2000 tons. The average amount of silver produced by these mines is 12 ounces for each ton of lead.

The Wheatley Mine raised during the last year over 1000 tons of dressed lead ore averaging 60 per cent. of lead. The galena ores of this mine yield from 70 to 85 per cent. of lead each ton, and from 15 to 120 ounces of silver. The phosphate ores yield from 66 to 72 per cent. of lead and five ounces of silver each ton.

Yield of the Mine.

The present market price of 1800 tons of 60 per cent. ore, being the whole amount produced by the Wheatley Mine since it began to yield, a period upwards of two years, at 6 1-2 cents per lb., in pig lead, would be, ...	157,248 00	
Deduct cost for smelting, a liberal estimate, ...	20,000 00	$137,248 00

Expenditures.

Amount paid for labor, ...	$53,389 66	
Amount paid for engines, machinery, materials, fuel, rent, implements of all kinds, buildings, water rights, &c., &c.	49,362 62	$102,752 28

It will be seen by the above figures that the Wheatley Mine has actually produced ore at the present market price more than sufficient to pay all its expenses.

It is proper to state that only 1400 tons of ore have been sold; the balance of 400 tons the Company has still in its possession. The 1400 tons were delivered to the Chester County Mining Company for four and a half cents per pound, under a contract made with that Company before the present rise in price.

All the necessary machinery for the preparation of ores, such as stamps, crushers, water-wheels, dressing-floors, &c., is completed, and there only remains to be procured a more powerful pumping engine to work the mine many years without any additional outlay. The time has now arrived, in the judgment of the owners, when such an engine should be procured. The success in working the mine thus far, and the wealth of the mineral vein so extensively developed in the short period of its operation, demand that this additional expense should be met by the stockholders without delay. There has been ore enough already produced, had it been sold for its market value, to pay for not only the working expenses of the mine, but all the permanent reduction works.

In addition to the results already attained, the following scientific opinions are referred to as evidence of the intrinsic value of the mine, and the importance of a more extensive development of its resources:—

Professor Henry D. Rogers, State Geologist of Pennsylvania, says, in his Report of May, 1853: "Of the productive half [of this vein,] a careful study of the Wheatley Mine, induces me to believe that the average yield in good ore, calculated to the square fathom, is from one and a quarter to one and a half tons."

Professor Silliman, in his Reports on the Mineralogical Department of the Crystal Palace, in Nos. 7 and 8 of the Illustrated Record, has the following: "We speak understandingly, and without exaggeration, when we say that the sulphates and molybdochromates of lead, in Mr. Wheatley's collection, are the most magnificent metallic salts ever obtained in lead mining, and unequalled by any thing we have seen in the cabinets of Europe.

* * * * * * * * *

"The geology of this metalliferous district of Pennsylvania, has been studied lately by Professor H. D. Rogers, who has made a special report to the proprietors upon it. From this report, and from our personal knowledge of the district, we have drawn what has been said. * * *

"We are happy to have it in our power to call public attention to this subject by so good an example of patient and skilful development at our own door. To give more distinctness to the matter, we have caused some diagrams of the Mining Machinery used at the Wheatley Mines, to be engraved for this article. Although such drawings may be of no special service to the experienced miner, they cannot fail to impress those who have no previous knowledge of the subject with the absurdity (not to say criminal disregard of others' interest), of those who rush ignorantly into the business of mining explorations with no other idea than the creation of some temporary excitement, during which innocent persons are induced to subscribe shares, with the certainty of failure before them. In view of the unhappy frequency of such examples, we hail with pleasure the exposition of Mr. Wheatley, as a token of some sure progress made in one of the great industrial and productive arts of this country."

The following is taken from Professor Wilson's Special Report on the New York Industrial Exhibition, presented to the House of Commons in February last:—

"The universal resources of this important State (Pennsylvania) were well illustrated by the fine and large collection of specimens which were displayed in this class. Foremost among these was a magnificent collection of lead ores, chiefly from the Wheatley Mine, near Phœnixville, which were contributed by Mr. C. M. Wheatley. These comprised specimens rarely met with of the chromate, molybdate, and chromo-molybdate, phosphate, arseniophosphate, sulphate, and carbonate of lead in splendid crystals, with samples of the galena and dressed ore. This mine is one of considerable interest, as it is, probably, the only one where systematic mining operations on any scale are carried out."

Again—"In respect to this particular mineral [lead], so far as I could learn, the mining operations are confined everywhere to mere surface-working, save at Phœnixville, in Pennsylvania, and one small mine at Arkansas. At Phœnixville, the mines under the able direction of Mr. C. M. Wheatley, are carried on perfectly upon the Cornish system, Mr. Wheatley having availed himself to the fullest extent, not only of the experience of our mining practices, but also of the practical skill of our men. The captains, as well as most of the miners, are from Cornwall; and in the office of the works, in which I was pleased to see well arranged cabinets, containing duplicate specimens of the beautiful ores he exhibited in Class 1, I recognized a draftsman and surveyor whose work was well known in the mapping room of the Museum of Practical Geology, in Jermyn street."

William Hobson, Esq., of Derbyshire, England, well known there as a practical and scientific miner, has addressed the following letter to Dr. Beales, of this city.

New York, 9th October, 1854.

J. C. Beales, Esq., M. D.,
Chairman of Committee of Wheatley Mining Co.

Sir,—I have just returned from an examination of the Wheatley and Brookdale Mines, both of which I find to have extraordinary indications, such as are rarely seen, and I feel fully persuaded that both will make rich mines when opened to a sufficient depth.

What I would advise first to be done, would be to sink Sanderson's engine shaft to 80 fathom deep, and then erect a steam engine for pumping, of 60 in. cylinder, and then drive levels along the lode at proper distances apart; all of which may be done with but little loss in time and at a small cost, as the ground is generally very easy worked.

When the works have been carried to sufficient depth, I have no doubt you will have rich mines for a long time to come.

(Signed), Wm. Hobson.

CHICAGO LEAD MANUFACTURE.

It is not perhaps generally known that the profitable manufacture of lead pipes is dependent upon the use of a patent, controlled by three establishments —one at New York, one at Philadelphia, and one at St. Louis, and that the owners would not dispose of the right to other manufacturers. St. Louis was expected to supply the north-west, and this market was furnished through an agency. The sale in this region increased to such magnitude, that the St. Louis manufacturers became satisfied that it was advisable to locate works at Chicago; and without loss of time after the opening of railroad communication with Galena, allowed lead to be brought there at no great expense, taking one month with another, than it would be transported from the mines to St. Louis.

Messrs. Collins and Blatchford, of St. Louis, have therefore established a branch of their works in that city. The temporary buildings are now completed, the machinery for making pipe is in full operation, and the proprietors expect to find this part of their works called upon to do an amount equal to the other, before the lapse of many years. The machinery for making sheet lead shall be put up as soon as possible, and in the mean time, a stock will be kept on hand of St. Louis manufacture. The permanent buildings of stone and brick will be erected outside and over those already constructed. The establishment is located at the corner of Clinton and Fulton-streets, near the Galena railroad depot, and not far from the river docks. The following extract from the circular of Messrs. Collins and Blatchford, conveys the truth in a nutshell:—"The uncertainty of the means of shipping from St. Louis to places north and east, and the consequent impossibility of supplying the wants of our customers with satisfaction to them and ourselves, from our works there, added to the increasing demand in this part of the country for our manufactures, has induced us to erect works at this point. The means of conveyance from here to all the principal parts of the north-west, and to the country contiguous to the lakes and the river St. Lawrence, are direct, expeditious and cheap."

The making of continuous lead pipe is an interesting process. It can be made a mile in length as well as any shorter distance. The molten lead is forced upward through a cylinder, bored to the size of the pipe, within which a sort of spindle forms the inside; the lead cools as it is crowded through the cylinder, and passes over a wheel to a reel where it is wound into coils. The pressure required to accomplish this result is immense, and gained by a hydraulic press, which can exert a force equal to three thousand tons. The pipe comes from the press with perfect uniformity of thickness and of remarkable smoothness, the interior being as bright as polished silver until the air has oxidized it. This factory will keep a constant assortment of the different sizes of pipe, from a quarter of an inch to five inches calibre, and sheet lead made of the purest and softest metal, ranging from 2 1-2lbs. to 30lbs. to the square foot.—*Chicago Democrat.*

COALS AND COLLIERIES.

ANTHRACITE COAL TRADE FOR 1855.

Shipments by Railroad, to May 19th	820,721 17	tons
" Canal, "	254,580 06	"
Total	1,075,302 03	"
Same time last year	914,252 00	"
Increase	161,054 03	"
Lehigh coal trade to May 12th	161,277 10	"
Last year	126,486 08	"
Increase	44,791 02	"

CUMBERLAND COAL TRADE FOR 1855.

Shipments from Jan. 1st to May 19th	184,183 02	"

SHIPMENTS OF COAL FROM PORT RICHMOND, FROM JAN. 1ST, 1855, TO MAY 19TH, 1855.

Compiled for the Mining Magazine, from lists furnished by M. S. Bulkley, Superintendent of Reading R. R., by H. W. Poole, Engineer, Pottsville.

	Tons.
Maine.	
Bangor,	447
Bath,	196
Eastport,	267
Gardiner,	183
Portland,	2374
Portsmouth,	9165
Rockland,	282
Saco,	1646
New Hampshire.	
Portsmouth,	2468
Massachusetts.	
Amesbury,	208
Beverly,	690
Boston,	68934
Cambridge,	968
Cambridgeport,	1364
Charlestown,	220
Chelsea,	651
Cohasset,	231
Danvers,	747
Dighton,	799
Dorchester,	548
Fall River,	12323
Gloucester,	163
Hingham,	141
Ipswich,	176
Lynn,	1762
Marblehead,	1020
Medford,	520
Milton,	824
Nantucket,	1165
Neponset,	830
New Bedford,	4855
Newburyport,	1764
Pawtucket,	1775
Plymouth,	531
Quincy,	147
Roxbury,	3675
Salem,	13245
Saugus,	290
Taunton,	277
Wareham,	225
Weymouth,	719
Rhode Island.	
Bristol,	213
East Greenwich,	965
Greenwich,	282
Kingston,	100
Newport,	3106
Providence,	17255
Warren,	858
Connecticut.	
Allyn's Point,	273
Bridgeport,	3561
East Haven,	195
Fair Haven,	425
Glastenbury,	190
Hartford,	4655
Middletown,	563
Mott Haven,	598
New Haven,	7287
New London,	1797
Norwich,	6348
Southport,	1423
Stamford,	740
Stonington,	150
New York.	
Albany,	3391
Carmansville,	133
City Island,	118
Craig's Landing,	116
Croton,	112
Factoryville,	214
Port Washington,	227
Flatbush,	220
Grassy Point,	425
Greenbush,	603
Green Point,	112
Haverstraw,	1385
Hudson,	963
King's Bridge,	110
Kingston,	100
Lansingburg,	197
New Brighton,	150
Newburg,	1386
New Rochelle,	130
New York, Brooklyn, Williamsburgh,	145140
Nyack,	107
Peekskill,	375
Piermont,	179
Port Chester,	740
Port Richmond,	432
Poughkeepsie,	1612
Rondout,	995
Saugerties,	214
Sing Sing,	1317
Stapleton,	1346
Staten Island,	1521
Stony Point,	1798
Tarry Town,	916
Tottenville,	85
Troy,	1394
Yonkers,	1368
West Chester,	539
West Point,	364
College Point, L.I.,	124
Flushing, L.I.,	1442
Sag Harbor, L.I.,	181
West Farms, L.I.,	254
New Jersey.	
Beverley,	657
Bordentown,	664
Bellville,	193
Bridgeton,	821
Camden,	4814
Carpenter's Landing,	234
Cooper's Creek,	484
Hainsport,	112
Hoboken,	1094
Jersey City,	3468
Kaighn's Point,	71
Keyport,	309
Lamberton,	95
Mandy Creek,	83
May's Landing,	65
Middletown Point,	211
Moorestown,	150
New Brunswick,	4116
Newark,	2119
Newport,	29
Perth Amboy,	272
Petty's Island,	751
Princeton,	118
Rancocos,	51
Red Bank,	169
Rondout,	1091
Salem,	1076
South Amboy,	165
Timber Creek,	40
Trenton,	192
Weymouth,	117
Woodbury,	267
Wood's Landing,	280
Pennsylvania.	
Bridesburg,	2041
Chester,	1634
Frankford,	4221
Holmesburg,	464
Marcus Hook,	331
Philadelphia City,	12785
Delaware.	
Delaware City,	248
Milford,	273
Newcastle,	79
Newport,	300
Smyrna,	117
Wilmington,	4285
Maryland.	
Fredericksburg,	261
Norfolk,	2247
Portsmouth,	234
Petersburg,	1075
Richmond,	4848
Williamsburg,	100
Virginia.	
Alexandria,	899
District of Columbia.	
Georgetown,	295
Washington,	3809
North Carolina.	
Edenton,	50
Newbern,	265
Wilmington,	856
South Carolina.	
Charleston,	9440
Georgia.	
Norwalk,	111
Savannah,	1698
Florida.	
Florida,	650
Jacksonville,	421
Key West,	1517
Alabama.	
Mobile,	515
Louisiana.	
New Orleans,	903
California.	
San Francisco,	1900
Foreign.	
St. Johns, N.B.,	1881
Cardenas, Cuba,	611
Havana, "	4123
Matanzas, "	178
San Juan del Sua, M.C.,	950
Monte Video, S. Am.,	77
Rio Janeiro, S. Am.,	250
Total to May 19th, 1855,	455,515
To same time last year,	391,422
Gain this year,	64,093

CHICAGO LEAD MANUFACTURE.

It is not perhaps generally known that the profitable manufacture of pipes is dependent upon the use of a patent, controlled by three establish —one at New York, one at Philadelphia, and one at St. Louis and the owners would not dispose of the right to other manufacturers. St. Louis expected to supply the north-west, and this market was furnished through agency. The sale in this region increased to such magnitude that the Louis manufacturers became satisfied that it was advisable to locate work Chicago, and without loss of time after the opening of railroad communicat with Galena, allowed lead to be brought there at no great expense, t one month with another, than it would be transported from the m St. Louis.

Messrs. Collins and Blatchford, of St. Louis, have therefore establi branch of their works in that city. The temporary buildings are now pleted, the machinery for making pipe is in full operation, and the propr expect to find this part of their works called upon to do an amount equal other, before the lapse of many years. The machinery for making sheet shall be put up as soon as possible, and in the mean time, a stock will be on hand of St. Louis manufacture. The permanent buildings of stone brick will be erected outside and over those already constructed. The est lishment is located at the corner of Clinton and Fulton-streets, near the rail railroad depot, and not far from the river docks. The following extract the circular of Messrs. Collins and Blatchford, conveys the truth in a n shell:—"The uncertainty of the means of shipping from St. Louis to the north and east, and the consequent impossibility of supplying the wants of customers with satisfaction to them and ourselves, from our works there, to the increasing demand in this part of the country for our manufacture induced us to erect works at this point. The means of conveyance from to all the principal parts of the north-west, and to the country contiguous the lakes and the river St. Lawrence, are direct, expeditious and cheap."

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COALS AND COLLIERIES.

ANTHRACITE COAL TRADE FOR 1855.

Shipments by Railroad, to May 19th	[illegible]0,721 17 tons
" Canal, "	[illegible]690 06 "
Total	[illegible]
Same time last year	[illegible]
Le[illegible]	[illegible]
Las[illegible]	[illegible]
Sh[illegible]	[illegible]

SHIPMENTS OF COAL FROM PORT RICHMOND, FROM JAN. 1ST, 1855, TO MAY 19TH, 1855.

Compiled for the Mining Magazine, from lists furnished by M. S. Bulkley, Superintendent of Reading R. R., by H. W. Poole, Engineer, Pottsville.

	Tons.
Maine.	
Bangor,	447
Bath,	196
Eastport,	267
Gardiner,	183
Portland,	2374
Portsmouth,	9165
Rockland,	282
Saco,	1646
New Hampshire.	
Portsmouth,	2468
Massachusetts.	
Amesbury,	208
Beverly,	690
Boston,	68934
Cambridge,	968
Cambridgeport,	1364
Charlestown,	220
Chelsea,	651
Cohasset,	231
Danvers,	747
Dighton,	799
Dorchester,	548
Fall River,	12323
Gloucester,	163
Hingham,	141
Ipswich,	176
Lynn,	1762
Marblehead,	1020
Medford,	520
Milton,	824
Nantucket,	1165
Neponset,	830
New Bedford,	4855
Newburyport,	1764
Pawtucket,	1775
Plymouth,	531
Quincy,	147
Roxbury,	3675
Salem,	13245
Saugus,	290
Taunton,	277
Wareham,	225
Weymouth,	719
Rhode Island.	
Bristol,	213
East Greenwich,	965
Greenwich,	282
Kingston,	190
Newport,	3106
Providence,	17255
Warren,	858
Connecticut.	
Allyn's Point,	273
Bridgeport,	3561
East Haven,	195
Fair Haven,	425
Glastenbury,	190
Hartford,	4655
Middletown,	563
Mott Haven,	598
New Haven,	7287
New London,	1797
Norwich	6348
[illegible]	[illegible]

	Tons.
City Island,	118
Craig's Landing,	116
Croton,	112
Factoryville,	214
Port Washington,	227
Flatbush,	220
Grassy Point,	425
Greenbush,	603
Green Point,	112
Haverstraw,	1385
Hudson,	963
King's Bridge,	110
Kingston,	100
Lansingburg,	197
New Brighton,	150
Newburg,	1386
New Rochelle,	130
New York, Brooklyn, Williamsburgh,	145140
Nyack,	107
Peekskill,	375
Piermont,	179
Port Chester,	740
Port Richmond,	432
Poughkeepsie,	1612
Rondout,	995
Saugerties,	214
Sing Sing,	1317
Stapleton,	1346
Staten Island,	1521
Stony Point,	1798
Tarry Town,	916
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College Point, L.I.,	124
Flushing, L.I.,	1442
Sag Harbor, L.I.,	181
West Farms, L.I.,	254
New Jersey.	
Beverley,	657
Bordentown,	664
Bellville,	193
Bridgeton,	821
Camden,	4814
Carpenter's Landing,	234
Cooper's Creek,	484
Hainsport,	112
Hoboken,	1094
Jersey City,	3468
Kaighn's Point,	71
Keyport,	309
Lamberton,	95
Mandy Creek,	83
May's Landing,	65
Middletown Point,	211
Moorestown,	150
New Brunswick,	4116
Newark,	2419
Newport,	29
Perth Amboy,	272
Petty's Island,	751
Princeton,	119
Rancocas,	51
[illegible]	169
[illegible]	1091
[illegible]	1076
[illegible]	[illegible]
[illegible]	[illegible]

	Tons.
Weymouth,	117
Woodbury,	267
Wood's Landing,	280
Pennsylvania.	
Bridesburg,	2041
Chester,	1634
Frankford,	4221
Holmesburg,	464
Marcus Hook,	331
Philadelphia City,	12785
Delaware.	
Delaware City,	248
Milford,	273
Newcastle,	79
Newport,	300
Smyrna,	117
Wilmington,	4285
Maryland.	
Fredericksburg,	261
Norfolk,	2247
Portsmouth,	234
Petersburg,	1075
Richmond,	4848
Williamsburg,	100
Virginia.	
Alexandria,	899
District of Columbia.	
Georgetown,	295
Washington,	3809
North Carolina.	
Edenton,	50
Newbern,	265
Wilmington,	856
South Carolina.	
Charleston,	9440
Georgia.	
Norwalk,	111
Savannah,	1698
Florida.	
Florida,	650
Jacksonville,	421
Key West,	1517
Alabama.	
Mobile,	515
Louisiana.	
New Orleans,	903
California.	
San Francisco,	[illegible]
Foreign.	
St. Johns, N.B.,	[illegible]
Cardenas, Cuba,	[illegible]
Havana, "	[illegible]
Matanzas, "	[illegible]
San Juan del Sur, N.C.,	[illegible]
Monte Video, S. Am.,	77
Rio Janeiro, S. Am.,	[illegible]
Total to May 19th, 1855,	[illegible]
To same time last year,	[illegible]
[illegible] this year,	[illegible]

THE PENNSYLVANIA COAL TRADE.

The following remarks by an enthusiastic friend of the Pennsylvania Coal Mines, state some valuable particulars. They are from the editor of the North American, and although occasionally indulging in a thrust at other regions, yet as these are harmless, they should not become a drawback on the interest of the facts:—

The prosperity of the Pennsylvania coal trade, its steady and large increase annually, and the wealth produced and accumulated by it, have excited the attention of the persons interested in other coal regions in the United States, or accessible therefrom. One weighty reason urged for the establishment of a system of commercial reciprocity with the British provinces of the North, was that the coal mines of Nova Scotia might be made accessible for the supply of the New England factories. Reciprocity is now in full force, and Pictou coal enters any of our markets without restriction. Yet, as we recently stated, the expectations of a large increase of that trade have been disappointed. The reason for this is alleged to be the low rate of freights; but the true reason is that the coal is not in demand in New England to the extent which had been previously supposed. Anthracite is supplied in unlimited quantites and at reasonable rates, and as long as this continues so, it must retain possession of the market, the more especially as it is far preferable to the bituminous coal of Pictou, with its attendant smoke. Great efforts have been made, also, to bring the Cumberland bituminous coal into competition with our own in the markets of the North and East, with only a limited success. Our anthracite mines are so much nearer to tide water, have such superior facilities for transportation, and the advantage of larger capital, experience and knowledge of the trade on the part of the operators, that, added to the superiority of the coal itself, it has little to fear from the Cumberland competition. The increase of the product of the Cumberland mines has been simply attributable to the natural surplus of demand which our own mines have been unable to supply. It must continue to increase with the multiplication of population north and south. Some years ago, New York speculators made a desperate effort to render the mines of North Carolina available as a means of competition with those of Pennsylvania, and at the time, there seemed to be an inexhaustible supply of capital at the command of the speculators to build railroads, work mines, and maintain lines of vessels, just the same as the Parker Vein operation, with its twenty steamships, etc. We have not heard any thing of the North Carolina affair for a considerable time past, and suppose, from the silence respecting it, that the financial panic has dealt with it as with so many other flourishing projects. These are about all the efforts yet made to bring other mines into competition with ours on the seaboard, and still Pennsylvania maintains the monopoly of the trade which she has so long and so profitably possessed.

All of these efforts are attributable to the desire of Boston, New York, and Baltimore to take away from Philadelphia a traffic which has given her an immense growth, without the advantage of a foreign commerce. They have foolishly imagined that to take this trade from us, it was only necessary to open mines in other regions, forgetful of the superior quality of our coal, and of the fact that many of their own citizens, capitalists and business men, are interested in maintaining the prosperity of the Pennsylvania coal trade. They have been endeavoring to bring into use varieties of coal, such as those which have begrimed the cities of England with black soot and smoke, and with them to supersede the smokeless anthracite already in use. A more formidable effort, however, is making to divert the coal monopoly from Philadelphia, by the construction of railroads leading from our anthracite mines to New York and Baltimore. To the latter city the Northern Central or Susquehanna line of railways is the avenue intended to convey the anthracite

of our northern coal fields. The company owning that consolidated line of railways, is now engaged in an effort to raise the means requisite for the extension of the line to the Shamokin region, and should this be done, it will be a valuable accession to the commerce of Baltimore and to the trade of the Shamokin region. New York is engaged in two efforts to make direct channels of transportation from our mines to her own doors. One is by the New Jersey Central and Lehigh Valley Railways, to be connected by a bridge across the Delaware at Easton. This is a direct road to the Lehigh coal mines, and bids fair to be of great service to New York as well as to the Lehigh interests.

It is to be regretted that Philadelphia has not long ago made a railroad connection between those mines and our city. As it is, the prospect seems to be that New York will be the first to have such a connection, and thus will possess an advantage over us, for, as yet, we have none but water communication, which is closed in winter. The North Pennsylvania Railroad has promised us a railway avenue to the Lehigh mines, but it is not yet built, nor are we able to say when it will be. The other effort to increase the coal trade of New York, to which we have alluded above, is the railway connection with the Lackawanna coal region, by means of the Delaware, Lackawanna and Western, and the Warren and New Jersey Central Railroads. With this Lackawanna region we have never had much communication. The Delaware and Hudson Canal, and its connecting railways, have the chief outlet of the trade, and that has conveyed it to New York. But the capacity of canals is limited, and the addition of a direct railway to the avenues to these mines is of considerable importance to New York. When the North Pennsylvania Railroad is fully completed, it will afford us also a direct route to the Lackawanna mines, and thus it will be seen that Philadelphia has a great stake in the construction of that road.

But whatever be the result of these efforts, whether Philadelphia shall retain or lose the monopoly of it, the trade itself is destined to be of such magnitude in the course of time, that it must be a source of immense wealth to many cities. We need not reproduce here the statistics of the trade to show the rapidity of its growth. They are doubtless familiar to most of our readers. The mere multiplication of population alone must cause the demand for coal to increase quite as rapidly hereafter as it has done heretofore. But the spread of manufacturing industry is destined to make it of still more importance as the consumption of coal therein is an item of primary importance. But leaving every other branch of manufactures out of consideration, the natural increase of the iron business is an item sufficient to attract more than ordinary attention.

MINERS' JOURNAL COAL ALMANAC FOR 1855.

We have received from the office of the Miners' Journal, published at Pottsville, Pa., a Coal Almanac for the year 1855, giving the anthracite coal trade of the United States for the year 1854, the quantity of coal sent to market by each company and individual in that year, designating, also, the kind of coal, whether red ash, white ash, or gray ash, from the Schuylkill and Shamokin regions. The coal from all the other regions in the State is white ash. It also embraces the semi-bituminous coal trade of the State. This almanac is worth the price of subscription to the Journal ($2 a year), to any coal dealer, large consumer, or coal land owner. Persons subscribing will, of course, receive a copy of the almanac. We also observe that a mining engineer, who is travelling a-foot through the mining districts of Europe, has been engaged as a correspondent for the Journal. A letter is to appear every two weeks, which will, no doubt, contain information of importance to those engaged in mining on this side of the Atlantic.

CREDIT DUE.

The April number of this Magazine contained summaries of the several reports of the railroads in the Schuylkill coal region. For these we were indebted to the Pottsville Miners' Journal, but by an oversight the usual credit was omitted, until it was too late to correct the press. We are now really glad that it was omitted, for the tables were originally prepared with considerable care and labor, and by the omission above-mentioned, we are afforded another opportunity to express in full that credit to which the Pottsville Journal is so highly entitled.

THE COAL TRADE OF YELLOW CREEK, OHIO.

Few seem to have formed any correct idea of the magnitude the coal trade of Ohio is destined to reach the next few years. The different companies organized within the last year, and the impulse given to coal mining in Jefferson and Columbiana counties seem to have awakened general interest towards the mineral resources of this section of Ohio. These companies are being put in working order, and we doubt not before navigation closes, their productive capacity will be taxed to the utmost extent to supply the increasing demands for coal.

Fuel is acknowledged to be one of the first necessities of man, second only to food, consequently is a ready sale; and where the article has been comparatively scarce and dear, as in many of the northern and western lake ports, during the severe winter just passed, it becomes a matter of vast importance to the several coal interests of Yellow Creek to examine a little into the supply and demand for the coming season.

At home we have passed through a severe winter for food, both for man and beast, but not so for fuel. Coal with us is always comparatively low; and probably no part of the Union enjoys so cheap a fuel as this section of Ohio. At the East, where exorbitant prices for all articles of food is the subject of great complaint, fuel too, enters largely into the cost with the other necessaries of life; and while we have brilliant prospects that the surface will again yield its share of the fruits of the earth, we have abundant reason to return thanks to the Divine Ruler of all things for the unlimited and permanent supply of fuel contained in our extensive coal fields.

Ohio coals have been obliged to stand a severe competition with those of Pennsylvania; and not until the large quantity mined and sent through the canals to our principal cities and towns, have the consumers of the latter become convinced that *Ohio Coals* are as well adapted for the various uses to which coal is applied, as those brought from the Pittsburg market. Hitherto, Pittsburg, and other parts of Pennsylvania, have not only supplied nearly all of the Lake ports with coal for illuminating gas, but are strong competitors with Ohio for fuel for steam, smith and foundry purposes. The prices, therefore, of Pennsylvania coals have always stood higher than those produced elsewhere, with perhaps the single exception of *Briar Hill*, from Trumbull county.

Within a few years past the demand from the Lake markets has constantly been increasing, and the present season bids fair to exceed all others, while the supply in Cleveland and Erie will be much larger than last season. The outlet for Yellow Creek coal is at Cleveland. The quality of the coal, we are glad to learn, is daily becoming better understood, and some of the smaller seams yield a coal that will successfully compete with *any* bituminous coal produced. It is our opinion that these coals will ultimately *displace a large portion of those brought from Pittsburg and elsewhere.* In fact, for gas, the Hammondsville coal gives a greater brilliancy to the light, being remarkably free from sulphur and other impurities.

On Yellow Creek there are *five* distinct strata, all varying in thickness and possessing different characteristics. The many purposes to which one kind of coal is better adapted than another, is exemplified by the following description of each seam, commencing with the lowest stratum above the surface, about midway between the mouth of the creek and the village of Salineville, viz.:

The "Creek Vein," four feet thick, pure and compact. This coal possesses intense heating powers, and for steam, smith, foundry and parlor uses, it is said to be an excellent article. It is found in great abundance on the property of the *Illinois Company*, at the Steubenville Road station, now New Salisbury. It cokes well, is easily mined, and owing to its solidity, will bear transportation almost equal to anthracite. When its qualities are better known, it will, no doubt, be eagerly sought for. The next above, is the "Strip Vein," known in the Cleveland market as "Hammondsville Coal." This coal we have alluded to before. It enjoys a reputation quite equal to the Pittsburg, and is rapidly becoming a great favorite as a gas, foundry, and blacksmiths' coal. For steam and domestic uses it has no superior. In fact, for every purpose to which a pure coal can be applied, the "Hammondsville," it must be acknowledged, ranks higher than that from any other seam on the creek. It meets with a quick sale, and will be extensively mined at Hammondsville, and by the New York and Ohio Company adjoining.

Above the "Strip" is the "Roger Vein," prevailing from the mouth of the creek to near Salineville. Openings have been made by the New York and Ohio Company, and the coal is said to be remarkably pure, and of course well adapted to a variety of purposes. Arrangements are making, we learn, to test the productive capacity of this seam by several of the companies who have it convenient for working. About thirty feet above is the "Seven Foot Vein," and for extensive production is one of the most important seams of coal lying in this section of Ohio. This vein has been extensively worked by the *Ohio Diamond Company*, at the mouth of the creek, and the cheapness with which it is mined, must always give for it a decided advantage in price over the coal from the smaller seams. For shipping, this coal must needs be in demand, as large stocks can easily be accumulated, owing to the easy process of mining so large a vein.

This seam is also worked by the *New York and Ohio Company*. The coal, however, is more brittle than that from the creek or strip veins; is by no means so pure, and consequently not so well adapted for manufacturing purposes; but makes an excellent fuel for stoves and grates, and for such must meet with an extensive sale.

The next is the "Cumberland Vein," between four and five feet thick, not much worked. There is a vein about the same thickness, worked by our friend Groff, on the Ohio River, near the mouth of Yellow Creek, called "Linton Coal." It is a good, free burning coal, carefully mined, and enjoys a considerable reputation in the Cleveland market.

It is said there is a bed of Cannel coal below the surface on the Illinois Company's property, about two feet thick, but the extent of this deposit, how susceptible of being profitably mined, or its quality, we have as yet been unable to learn. Other formations of bituminous coal are said to lay above and below the surface, but no analysis or correct information as to their character, can be found.

The valley of Yellow Creek is rich in iron ore, fire clay, and most of the elements to sustain an enterprising class of manufacturers. At no distant day we expect to see iron furnaces, brick factories, saw and grist mills on the creek. The rich bottoms are ample to feed a population ten times larger than they now have.

Some estimate may be made of the value of the coal trade to Ohio, and to her canals and railroads (independent of her other minerals and vast agricultural resources), by the following table of production from each county in 1854, actually sent to market, viz.:

TRIBUTARY TO THE OHIO RIVER.

Meigs county	285,000 tons.	
Muskingum county	70,000 "	
Belmont county	36,000 "	
Lawrence county	68,000 "	
Athens county	54,000 "	
Jackson county	85,000 "	
Vinton county	12,000 "	
Jefferson county	8,000 "	
Washington county	8,000 "	
Monroe county	7,000 "	
		583,000

TRIBUTARY TO THE LAKE.

By Canal—Summit county	145,000 tons.	
" Stark county	84,000 "	
" Trumbull county	17,000 "	
" Coshocton county	12,000 "	
" Tuscarawas county	17,000 "	
By R. R.—Columbiana county	18,000 "	
" Jefferson county	16,000 "	
		257,000
Total tons		840,000

In addition, Licking and Morgan counties produced 10,000 tons, most of which was consumed in the interior. This trade is susceptible of being doubled within the next two or three years. As the supply of wood, as a fuel, becomes diminished, and the price increases, new openings will be made for coal in every locality convenient to a market. We know of no place where production can be so succesfully carried on as upon Yellow Creek. The only drawback is the limited facilities of our railroad company for dock room, at Cleveland. At present, no inconvenience has been seriously felt in the want of means for transportation, although confidently predicted by many in interest. Before a large business can be done, good and safe accommodations, at Cleveland, must be provided for receiving, unloading and shipping coal. The want of these must necessarily retard the growth of the coal trade from Yellow Creek. While upon this subject, we may as well state that many complaints have been made against the Cleveland and Pittsburg Railroad Company, for the want of spirit in not fostering the growth of the coal trade tributary to their road; but in our opinion, *unjustly*. It must be remembered that nearly every railroad company in this section of the Union has, for the past twelve months, been obliged to contend with short crops, stringent money markets, and deranged finances. If our own appears to pursue a system of retrenchment in regard to its freight and passenger traffic, it is commendable, and reflects much credit upon the superintendent of the road; for no company will be so blind to their true interests as to withhold the facilities for transportation, or room for stowage, when it is manifest those facilities are required.

The consumption of coal in our large towns and cities is every year increasing, as well as the demand for shipping.

Last year	Cincinnati	received	300,000 tons
"	Cleveland	"	250,000 "
"	Columbus	"	35,000 "
"	Chillicothe	"	12,000 "
"	Circleville	"	6,000 "
"	Dayton	"	4,000 "
"	Sandusky	"	55,000 "
"	Toledo	"	18,000 "
"	Other sources	"	20,000 "
	Total		700,000 tons.

It is estimated that the smaller towns consume 200,000 tons more. It will be seen that Columbiana and that part of Jefferson where the Yellow Creek

coal is found, furnished for transportation over the Cleveland and Pittsburg railroad, for the first eleven months of 1854, as follows:

From the Mouth of Yellow Creek	11,129 tons.
" Hammondsville	4,096 "
" Steubenville Road	171 "
" Salineville	11,315 "
" Rochester	3,500 "
Total	30,211 tons.

Now, this is a small quantity compared to the whole production of Ohio. The present year, however, will no doubt witness a very large increase in the supply from these two counties. During the first eleven months of last year, it appears the Cleveland and Pittsburg railroad company transported over their road 41,098 tons of coal; of which the Yellow Creek fields supplied 30,211. tons; Pittsburg, 5,297; Darlington, 5,528. It is estimated that 150,000 tons will pass over the road for the current year, ending 30th November next, of which 100,000 tons will be mined and sent to market by the different interests on Yellow Creek. We have heard much higher estimates of their productive capacity, but are of the opinion that the present means for transportation will not permit a larger quantity to go forward during the coming season.

The demand for coal from the northern and western markets will no doubt be on a larger scale than at any former period. The rapid growth of the west increases consumption in a remarkable degree. When we look at the immense quantity of coal consumed in all our Lake markets for household fuel and manufacturing purposes, in addition to what is required by the fleet of steamers and propellers on the lakes, it must be manifest that the demand will tread close upon the heels of consumption, and that the supply cannot augment at any point where coal has heretofore been used. By a careful estimate of the quantity of bituminous coal required in and about the several cities and towns on the lakes, and by steamers and propellers, it will be seen that there can be no cause for solicitude about overstocking markets or clashing of rival interests. We find them as follows:

	FOR GAS.	FUEL.	TOTAL.
	Tons.	Tons.	Tons.
Chicago	8,000	70,000	78,000
Milwaukie	2,000	25,000	27,000
Detroit	2,000	20,000	22,000
Toledo	2,000	15,000	17,000
Sandusky	1,500	10,000	11,500
Cleveland	3,000	60,000	63,000
Toronto	1,500	15,000	16,500
Kingston	1,000	12,000	13,000
Buffalo	8,500	48,000	56,500
Other Lake towns	10,500	100,000	110,500
	40,000	375,000	415,000
Add to this the quantity of bituminous coal consumed by steamers and propellers on the Lakes during the season of navigation			225,000
Total			640,000

Now, as to supply, we will assume that Cleveland will get this year, from the Canal, 25 per cent. more coal than last year; this will give from that source	220,000 tons.
From Yellow Creek, by C. and P. R. R.	100,000 "
" Pittsburg, over same road	40,000 "
" Erie and other places	110,00 "
Total	470,000 tons

equal to 18,000,000 bushels. Here then is a short supply of 170,000 tons, without calculating for any increase in the consumption for the manufacture

of iron, or other branches of industry, which have been more or less paralysed during the past year.

In our estimate, we make no allowance for the markets of Canada thrown open to us by the reciprocal treaty with the British North American provinces. We look for a large demand from this source, and believe, by the admission of our coal duty free, its use would be increased four-fold: provided prices are kept down so as to encourage consumption.

We see no reason why the coal interests of Yellow Creek cannot equal in production those of any other section embraced in our great western coal basin, and if the several interests briefly alluded to are not successful in their new enterprises, it will not be from any want of natural advantages.—*Wellsville Patriot.*

IRON AND ZINC.

IRON OF WASHINGTON AND DODGE COUNTIES, WISCONSIN.

Annexed we insert the valuable report of that able geologist, Mr. James G. Percival, on the iron ore at Iron Ridge and at Hartford, in Wisconsin:

The iron ore, at Iron Ridge, Dodge county, and Hartford, Washington county, is a red peroxide of iron (of the same species as specular iron and red hematite), chiefly of the variety called lenticular ore (seed or shot ore). It forms a bed interposed between two limestone formations; that below obviously corresponding in its physical character and fossils to the upper shell bed of the blue limestone of the mineral district, and that above in its physical character to the upper magnesia of the same district. Fossils are very rare in this overlying rock, and those chiefly corals, near the junction of the rock with the ore. They are quite different from the fossils in a corresponding situation in the upper magnesian, so as to render the determination of the overlying rock not immediately obvious. The ore bed has the same relative position in regard to the underlying rock as the *brown* and *green* rocks of the mineral district, which are situated at the base of the upper magnesian, immediately above the blue limestone. Those rocks are highly stained with iron, particularly the brown rock, which has nearly the color of the present ore, and accompany the lower mineral openings of the upper magnesian, in which the lead ore is associated with large quantities of iron ore (sulphuret of iron, and brown hematite; the latter derived from the decomposition of the former). The iron ore, at the two localities above mentioned, is the same in its character and arrangement, and has the same geological relations. It forms, in its original position, a bed of thin slaty rock, composed of small flattened smooth grains, with some larger connections intermixed either of a mammillary form, or resembling very smooth rolled pebbles, but these obviously concretionary. The bed is generally very uniform in its character, but with occasional thicker and more compact layers. It is usually overlaid by a layer, 3 to 4 inches thick, of a very hard dark form, blue seamed, compact ore, breaking with a conchoidal fracture, with occasional glossy seams of specular iron. This layer in some instances adheres firmly to the limestone above, and points of the same ore or stains of the red oxide are found more or less disseminated through the adjoining rock. Iron pyrites is also found disseminated through the immediately overlying limestone, and may be observed in the same block apparently passing from the unaltered pyrites at the centre to red oxide at the surface of the block. At Hartford irregular layers or pockets of red and white jointed clay, blended in larger and smaller segregations or patches, are formed in the

limestone a few feet above the ore, very similar to the joint clay of the openings in the mineral districts, particularly those in its lower bed of the upper magnesian. This clay breaks by smooth seams into more or less regular fragments, sometimes very small, like those of the soap clay immediately investing the lead ore in some openings in the mineral districts. The rock adjoining these pockets of clay contains an unusual number of fossils (corals), like that immediately overlying the ore. The ore is underlaid by a bed of red and blue clay, accompanied with fragments of a greenish concretionary limestone, with few or no fossils resembling similar concretionary layers in the lower part of the upper magnesian, and this by the upper shell bed of the blue limestone, usually much decomposed and broken, and accompanied with alternate layers of blue clay, as in the mineral district.

At Iron Ridge, the ore bed underlies a line of bluff of the overlying limestone, about 80 feet high, extending 1 1-6 mile nearly north and south (N. 8° E.) This bluff is interrupted for about a quarter of a mile at the Mayville ore bed, and terminates abruptly both at the north and south; the limestone bearing around nearly from west to east. The height of the ridge from the valley west is about 60 feet; the upper half, limestone; the lower half occupied by the ore bed, and the underlying clay and blue limestone. The limestone in this bluff is thick bedded, hard and compact, of a very light gray color, and burns, though with difficulty, into a good white lime. The ore bed, where exposed by excavations as it underlies the rock, is composed of a very uniform mass of thinly schistose iron stone [rock ore], of a light red brown color, but giving a bright red powder, and made up chiefly of very small flattened grains [seeds] of argillaceous red oxyd, with some larger smooth concretions disseminated. This is quite firm where formed in the pits sunk through the rock back of the bluffs, but softer in the excavations at the bluff, showing a tendency to disintegration. Where the ore meets the thick-bedded rock above, a band, 2 to 4 inches thick, intervenes, composed of a very hard compact dark-brown ore, giving a bright red streak and powder, and with occasional seams of specular iron. But in some instances a thin slaty marl is interposed between the limestone and the ore, and in such cases the hard band appears to be wanting. At one of the excavations in the face of the bluff, a thin band of a brown ferruginous limestone was found interposed in the ore, about six feet from its upper surface, thinning out towards the west, and becoming thicker as it passed under the limestone.

On the slope of the ridge below the limestone, and at the Mayville bed in the cove between the two sections of the limestone bluff, and the south end of the ridge beyond the southern termination of the limestone bluff, the ore occurs loose and incoherent, but composed of the same small flattened grains, as the rock ore, with a few larger concretions intermixed. The ore here is arranged in layers, but less regularly than in the original bed, with more or less clay intermixed, both in horizontal and vertical seams, and with interposed irregular beds and pockets of bluish joint clay and a yellow brown loamy drift with boulders of limestone; the whole presenting the appearance of a drift accumulation. The limestone and the underlying ore may be supposed to have originally extended farther west, and to have been removed by the action of water, and the rock ore to have been disintegrated and then accumulated by eddies in the cove at the Mayville bed, and at the south end of the ridge, and to have been deposited by more gradual action, along the general slope of the ridge. This view of the subject will explain the great variety in the thickness of the loose seed ore at various points along the ridge; at the Mayville bed, including the interposed beds of clay and drift, about 30 feet, and at the summit of the south point of the ridge, about 20 feet, while on the slope of the ridge it gradually thins off from 8 to 10 feet above, towards the bottom.

Pits have been sunk through the rock at different distances from the bluff, and show the same arrangement of the bed as in the excavations in the rock

in the face of the bluff, only less altered and disturbed. The thickness of the bed under the rock, in the south part of the ridge, appears to be about 15 feet. In one pit it was found to be 12 feet, but here the ore or the clay beneath, appeared to have been removed by the action of a spring, causing a sinking of the rock at that point. At the north end of the ridge, in the bluff north of the Mayville bed, the thickness of the bed under the rock, averages 10 feet (in one pit 12 feet). A higher bluff of limestone extends along the west face of the ridge, from two to three miles north of Iron Ridge village, where two pits have been sunk below the rock of the bluff, showing a mere seam of the iron ore under the overlying limestone, below which, in one of the pits, the same clay and blue limestone were found as under the ore bed at Iron Ridge. The limestone bluff is there more than twice as high as that at Iron Ridge, and shows beneath the same thick-bedded rock as at the latter, overlaid by a bed of nearly equal thickness of a thinner-bedded limestone breaking into small jointed fragments, and this by another bed of thick-bedded rock at the summit. The rock throughout is there as little fossiliferous as at Iron Ridge. The arrangement in these distinct beds corresponds with that common to all the limestone formations of the mineral district.

At Hartford the ore bed crops out under earth, on the west slope of the ridge at the village, south of the Rubicon, and in the south bank of that stream, and has been traced in wells and pits through the ridge to its east base adjoining the Rubicon. It is overlaid on the west, first by earth, then by a very thin bed of limestone in places, but disjointed; and farther east by a firm bed of the same rock, 6 to 8 feet thick, under about 20 feet of earth, but again appears on the east slope as on the western. It has been sunk through only in one pit, towards the west, under the disjointed rock, and is there 7 feet thick, but thins out on both slopes, particularly on the eastern. The ore appears here harder than that at Iron Ridge. The loose seed ore is found only in comparatively small quantities on the west slope of the Ridge, where the ore is separated from the limestone above by the same hard band as at Iron Ridge, presenting similar seams of specular iron. Pits have been sunk in the Ridge next east, where there is the same appearance of thinning out to a seam as in the high bluff north of Iron Ridge. These two instances indicate a thinning out both to the north and east, and the same if opportunity offered might probably be shown in the south and west. No discoveries of this ore have yet been made, except those at Iron Ridge and Hartford. The thin layers of red earth containing a few grains of the ore disseminated found on the surface of the drift at a few points south-east of Iron Ridge are undoubtedly due to the action of water, and are derived from that bed. It would seem probable that the ore forms extensive lenticular deposits or basins, thinning out around their edges, and occurring at different points along the junction of the two limestone formations between which it is included. The thickness of the ore would naturally differ in different deposits, according to their extent. Thus the deposit at Iron Ridge which has been traced at least 1 1-4 miles north and south, and nearly the same distance east and west, shows a thickness of 15 to 16 feet under the limestone rock, while that at Hartford, which has not been traced to half that extent, shows a thickness of only seven feet. The available extent of the Hartford bed, on the north, is limited by the Rubicon, which runs from east to west, along the line of an apparent fault; the ore bed rising several feet above the level of the stream on the south, and the limestone presenting the same characters as the overlying limestone on the south, sinking below the level of the stream on the north.

From the statements above it will be seen that the ore available in quality occurs under two forms; the rock ore, its original form as it lies in place under the limestone, and the loose seed ore which has been apparently formed from the disintegration of the rock ore, and more or less modified in its deposition by drift action. The composition of the two cannot essentially differ, except that the latter is more or less intermixed with clay, and may have

been modified by the action of decomposed organic matter, as in bog ore. A careful analysis of the two would determine the latter question. The loose ore is more easily excavated, but the rock ore would be reduced with greater facility, from its coherence. The hard band immediately adjoining the limestone above, although probably of superior quality, is in too small quantity to be of any importance, and is interesting only in pointing out the character of the ore.

The bed at Iron Ridge occupies an extent of nearly one mile from north to south (the Mayville bed not included), along the side of a ridge where the bottom of the bed is above the base, so that the whole bed admits of easy drainage. The thickness of the bed under the rock varies from 10 to 15 feet; at the south point (at the village), where the furnaces are to be erected, about 15 feet. By placing the furnaces at the side of the bluff at the thickest part of the bed, the ore may be brought to them immediately, almost without labor. The large deposit of loose ore at the south end of the ridge (in one point 20 feet thick), is in the immediate vicinity, and the ore could be conveyed to the furnaces with nearly equal facility. Either of the two might thus be used, or the two might be mixed as would be found most advantageous. But the rock ore would most probably be used to most advantage, and with its known extent would be inexhaustible.

This great deposit of ore is fortunately in the midst of a very extensive tract of heavily timbered country, which with due economy might for a long period furnish an abundant supply of fuel, and that of the best kind for the furnace, as the superiority of charcoal iron is acknowledged. The whole face of the ridge presents a series of springs, issuing both above and below the ore, and affording an abundant supply of water for steam power. The bed at Hartford is in the same heavily timbered country, and on the immediate bank of the Rubicon, a large mill stream. The Milwaukee and Horicon Railroad passes through Hartford Village, and only 1 1-4 miles from the village of Iron Ridge, and will be connected with the latter by a branch leading directly to the works. The surrounding country is of a superior character for agriculture, and will furnish abundantly all necessary supplies. It will thus be seen that these localities, particularly that at Iron Ridge, furnish the most desirable advantages for the manufacture of iron, and by the connected railroads for the transportation of the iron and the ore, from its abundance, besides supplying the most extensive establishments on the spot, might be conveyed to other points, more or less remote, where it might be required, and that with great facility from the conveniences of transportation, and thus every advantage might be taken of this vast deposit.

James G. Percival.

The above report is accompanied with the following remarks by a daily paper at Milwaukee—the *News*—which states some commercial particulars of importance.

We alluded a few days since to a report of the State Geologist, relating to the large and valuable deposit of iron ore at Iron Ridge, with the remark that we should give it a more extended notice soon. We have read that paper with great interest, and are fully convinced that there is, slumbering at our threshold, one of the most important elements of wealth which exists within the boundaries of the State.

This body of ore extends over an area equal to about a mile and a quarter square, and at an average depth of about fifteen feet, which it is obvious will be inexhaustible for many centuries. It is said to smelt with a smaller amount of fuel by 25 per cent. than any ore known in the United States, and works with equal ease in the puddling furnace, producing the first quality of bar iron. This ore bed is situated in one of the heaviest timbered portions of the State,

the predominant timber being oak and maple, or sugar tree, which are found to produce coal of the first quality, and in such an abundance as will admit of no scarcity for thirty years to come, and from which a supply of coal can be drawn for a much longer time at a reasonable cost. Before the surrounding forests will be exhausted, some substitute will doubtless be found to supply the place of charcoal, and thus the supply of mineral be made available from these mines for centuries.

There are but few deposits of iron to an equal extent in the United States, and none of those which have been discovered can be made so productive at so small cost as this at Iron Ridge. The iron from the Iron Mountains of Missouri and Lake Superior, is quarried and smelted with a much greater expenditure of labor and capital, and the iron resulting, is of no better quality when obtained. The Iron Ridge mines are in the immediate vicinity of the most beautiful and productive agriucltural region of the State, whence supplies of provisions, labor, and all that is needful can be drawn at the cheapest rates, and in the most abundant quantities. The ore from the mines of Lake Superior and Missouri delivered at the furnace will cost some three dollars per ton, or about six to seven dollars for the amount of ore required to make a ton of pig iron; while the ore at Iron Ridge is obtained with such facility that it can be delivered from the mines to the furnaces erected at the foot of the ledge for TEN CENTS PER TON, or a sufficient amount of ore to make a ton of pig iron, can be delivered at the furnace for TWENTY-FIVE CENTS!!! Such a fact is unparalleled in the history of mining, but is believed to be a sober reality at Iron Ridge.

Thus the expenditures required for working the Lake Superior mines, are in a great measure avoided or greatly reduced, which in the large operations of a heavy iron establishment, would amount to the saving of thousands, and perhaps hundreds of thousands of dollars annually. We look upon this as one of the most valuable treasures of our State, greatly superior in its effects upon our domestic industry and wealth, to the richest gold mines, or the most extensive veins of lead and copper. These are all valuable in their way, but none of them add so much practically to the permanent wealth and improvement of the country in which they are situated as do iron works in favorable locations. Such works not only furnish employment for a large number of persons in the various departments, but the production of their labor is an article of primary necessity in all the arts and business of life, and the demand for it is unlimited, as the supply of the raw material is inexhaustible.—These mines are situated on the La Crosse and Milwaukee Railroad only forty-five miles from this city, which will afford a ready means of communication and a market east and west by the navigation of the Lakes, to all the cities and ports, holding the key to the markets of Illinois, Indiana, Michigan, Ohio, Pennsylvania, New York, and Canada; and by the Mississippi, to the western and north-western regions beyond us, not forgetting the large market which the State of Wisconsin itself will furnish, more valuable perhaps than all the others put together.

We understand that our fellow citizen the HON. BYRON KILBOURN, late Mayor of this city, is the principal proprietor and owner of this great body of mineral, and that he offers great inducements for the investment of capital in the erection of works and entering into the manufacture of iron, both in the form of cast and bar iron. For this purpose we are informed a charter has been obtained from the legislature with ample powers and guaranties, and the opening and opportunity for the investment of capital are such as seldom offer. All the circumstances considered, embracing locality—cheapness of obtaining and smelting the ore—facilities in obtaining supplies and convenience of market—there is probably not in the United States another locality which holds out stronger inducements for the investment of capital on a large scale, than the iron region referred to.

ANCRAM IRON COMPANY.

The property of this Company is located at Ancram, Columbia County, New York. The report of Mr. William Bushnell, from which we extract such parts as may be of general interest and importance, contains a description of the property—of the present state of the works, and estimates for the erection of blast furnaces.

It is anticipated that the works can be carried on with success, in spite of the national tariff policy:

The mines are located, respectively, about three and a half and four and a half miles from a point on the Harlem railroad north of Boston Corner station, suitable for the junction of a branch road—the entire distance from this point to the mines, presenting great facilities for the construction of a road with very slight grades and small amount of excavation and embankment.

The first, or nearest mine, is upon the farm of Elias Reynolds, Esq., and is situate on the western slope of a range of elevated land, extending for several miles in a south-westerly and north-westerly direction, and known as the "Winchell Mountain," and is remarkably well located for economical and advantageous working upon an extensive scale. The present openings are made in a well-cultivated field, just west of the residence and farm buildings of Mr. Reynolds, having an inclination to the south and south-west, and bounded on the south by a good sized farm brook, from which an abundant supply of water can always be obtained for washing the ore; thus giving the miner an advantage that few mines possess, and at the same time secure to the parties using the ore, a pure and well-washed mineral, which it is well known is quite an item in the manufacture of iron, consequent upon the saving in the expense of transportation, and upon the diminished per centage of coal necessary to reduce it. The explorations have thus far been made by Mr. Reynolds, simply to determine whether he really possessed a mine or not, and strange as it may seem that a person without any pretension to geological or mineralogical knowledge, should at first trial succeed in striking an important deposit, yet such is the fact, and out of some five or six shafts or pits sunk by him, all but one (and that one being at the extreme easterly side of the bed) were settled directly upon the solid mass or bed of as handsome and as pure brown hematite iron ore as I have ever seen. The deepest of these pits is 14 feet, and the shallowest 8 feet—the less depth of earth covering the ore as you ascend the slope of the field north-easterly, and in every pit the ore is pure and full of forty per cent. metallic iron at the very surface or crown of the bed. The openings are some rods apart, and altogether embrace considerable surface of ground, thus proving conclusively that the deposit is continuous, and not in pockets (as miners term a broken and disjointed bed). At the most westerly opening a drift has been carried in horizontally fourteen yards, and a compact mine found the entire distance. There are, I should judge, some three hundred tons of ore now on the surface, taken from the various openings, all presenting the same general appearance and characteristics of the Salisbury ore. And I doubt not, but that it is identical with that ore in every particular, being in the same geological range, and in the same formation. The belt containing this ore I should judge to be some thirty to forty rods wide easterly and westerly, and from the indication in the fields on the north and south, I should judge the mine extends under them both, and probably much further in each direction. There are no unusual or extraordinary geological formations in the vicinity, other than such as follow this variety of ore—and this fact I hold to be important, as showing nothing more nor less than the ordinary indications of a good substantial and reliable mine of great extent and easily wrought.

The other mine is about one mile south-westerly from this, and is on the farm of Hugh McClellan, Esq., and presents the same general features of the one

just described, except that the field in which it lies has an inclination to the north-west, and the ore at the surface of the mine is not so rich and so pure—yet to make up for this difference, it has less superincumbent earth upon it, and the pure ore will undoubtedly be reached with as little expense as that in the Reynolds mine.

This mine has also been opened in many places over a large extent of territory, thus showing it to be of very large dimensions, and capable of producing an immense amount of ore. The advantages for washing the ore at this mine are also superior, there being a fine stream of water passing directly across what I take to be the centre of the mine, with a good fall, even better than that at the Reynolds mine, and affording an opportunity of erecting the most efficient wash-works of the day, capable of washing a ton of ore every five minutes, if necessary, and doing it, too, in the most perfect and complete manner. I observed one peculiarity at this mine deserving of notice, and that is, the presence of quite a per centage of white carbonate of iron, mixed with the hematite, in lumps varying from a few ounces to several pounds in weight. This mineral, you probably are aware, when used as a mixture with hematite, adds greatly to the value, on account of the superiority of the iron produced, as well as in the economy of reducing. The width of the belt containing the ore at this mine is probably about the same as at the Reynolds mine, and the longitudinal extent is undoubtedly equal to the entire length of the farm.

That a full and adequate supply of ore, that may be obtained at reasonable mining cost, is indispensable to the success of an enterprise like yours, is well understood, and therefore, gentlemen, it behooves every man who contemplates investing in the stock, to be satisfied beyond peradventure, that his confidence in this particular is well grounded, and in view of this fact, it also behooves me, gentlemen, to be not over-sanguine in my report to you upon your contemplated source and supply of mineral, yet I feel that I may safely say to you, that with these two mines combined, you will possess every requisite in the way of hematite ore, and may safely calculate upon an inexhaustible supply for many years to come; and I feel assured that whomsoever you may invite to examine them, will coincide with me in this opinion, as the evidences in support of it are of a character not to be misunderstood by any one acquainted with this kind of mineral deposit. I would, however, by all means, recommend the use of a small proportion of primitive ore as a mixture, not so much by way of improving quality, as in producing quantity, and in economy of smelting.

This variety of ore is much more abundant than the choice hematite, and very little thought need be given as to whence the supply is to come, as it can always be obtained at reasonable prices and on short notice. I have thus, gentlemen, given you in few words, and in plain unpretending language, a description of the mines upon which you are to rely for the main supply of ore for your works; and as I have aimed to keep within the bounds of truth and justice, I trust that the result will bear me out, and that I shall have the satisfaction of your entire approval of all I have said upon the subject.

Report upon the Works.

To those acquainted with the history and success of that noble monument of enterprise, now adorning the southern limits of your city (the Hudson Iron Works), I need not say one word to convince them of the propriety of establishing, by its side, another of like character; yet, as there may be invitation extended to those who are not familiar with the success of that enterprise, to join you in this, a few words and comparisons may not be out of place.

The iron trade, gentlemen, I need not tell you, has for generations past been one of the noblest, and upon the average, one of the most lucrative branches of industry of our country, and so it must continue for generations to come. It is true there have been some individual cases of ill success, consequent upon unfavorable location of works, upon the inferiority of the iron produced,

or upon the lack of means necessary to encounter the ordinary revulsions of trade and commerce. It is probably, also true, that there has been, here and there, an isolated case of failure arising from sheer mismanagement and incapacity for conducting the business. And it is not at all surprising that failures should result from such causes as I have named, or that such causes should exist, when we reflect upon, and take into consideration, the enterprising and go-a-head spirit of our people, and the great fluctuation in the value of Iron during the past twenty years. The only wonder is, that with the many ill-chosen locations and the inadequate means with which the business has been carried on, there has not been a much larger percentage of ill success than really has resulted.

Again, gentlemen—not that I would attempt to drag into this brief report any thing savoring of political feeling—yet I may say it is well understood, that the vacillating policy of our Government has been such, during the same period, as to delude and ruin many of our citizens, in various manufacturing enterprises. The high protective tariff of to-day inducing them to invest in business of inviting aspect, which to-morrow, under almost free-trade principles, must inevitably wither and fall to the ground; and simply because, that under the rule of high tariff and high prices, they were induced to make investment, regardless of the fitness of the location, or the chances for competing with their foreign rivals under low tariff and low prices. This, gentlemen, is the point to which I would invite your attention, for if your position in this respect is not impregnable, then it behooves you to be cautious in your investments; not that I, by any means, believe we shall ever, or at least for very many years, have free trade; but that in selecting a location for large manufacturing purposes, we should always seek that point at which the raw material to be used, can be the most readily and economically concentrated, and where, when the product is turned out, it can be placed in market at the least possible cost of transportation; thus enabling us, in as great degree as possible, to be independent of the whims and caprices of Legislators for the success of our undertaking, and to bid defiance to low tariffs and foreign competition. Therefore, gentlemen, if it shall appear upon examination, that your proposed location has these several advantages, and that you can compare favorably with other kindred and well-located American establishments, then you have nothing to fear, and may safely and freely invest with the greatest assurance of liberal dividends upon your capital.

In order to institute these comparisons, and ascertain what the facts of the case are, as regards your advantages, it is only necessary to turn to a few statistical items, bearing upon the subject, which, together with the proper estimate of the cost, and character of the iron you propose to make, will give you the data.

According to the annual statement of the iron masters of the river Clyde in Scotland, for the year 1848, it appears that the average cost of pig iron, delivered on the Clyde for that year, was, in round numbers, $12,50 per ton; while in Wales and Staffordshire, the average cost was about $18,75 per ton, which adding the ordinary expenses of importation would make the cost of the Scotch pig, delivered in New York, about $19,50 per ton and the Engish and Welsh pig over $26 per ton, even though it came in duty free. And it must also be borne in mind, that the year of 1848 was one of unusual low wages in Great Britain. Coal miners and ore miners receiving only from 11 to 12 shillings sterling per week; keepers and fillers in furnaces receiving 15 to 17 shillings sterling per week, while all other labor was equally low in proportion, whereas now, those species of labor command more than 50 per cent. advance, and will probably continue to command it for a long period of time. California, Australia, and other places of mining enterprise and interest having drawn off a large proportion of the very best miners and iron workers in the kingdom, which with the constant drain in the same direction of the remaining portion, and of the new recruits the moment they

are able to leave, must tend to keep up the price of labor in the mining and iron branches of British industry. And so long as that is the case, there is very little to fear from foreign competition in the iron trade of this country, particularly with well and judiciously located establishments. I might enlarge very much upon the chances against foreign competition, and fill my entire space with statistics to show you that we have seen our worst times in that respect, but I do not deem it at all necessary, or of any further relevancy to the question in hand. In order however to show you what you have to compete with at home, I will give you the cost of producing and delivering in New York, pig iron from the great Lehigh Valley region of Pennsylvania; that being the most accessible, and most formidable American rival you will have to contend with.

The average cost of coal delivered at the furnaces throughout the valley, is about $3 per ton. The average cost of hematite ore yielding 40 per cent. is $2,12½ per ton; average cost of magnetic ore is $3,75 per ton; average cost of limestone is $1 per ton, which, as they ordinarily run, makes the account stand thus:

Two tons coal, $3 per ton	$6 00
Two do. hematite ore, 17s. per ton	4 25
One third do. magnetic ore, 30s. per ton	1 25
Three fourths do. limestone, 8s. per ton	0 75
Labor and incidentals, say	4 00
Transportation to New York	2 62
Making the cost per ton at tide water	$18 87

or 62 cents less than the cost of Scotch pig iron laid down in New York, without duty added.

The probable cost of making iron at Hudson will be, allowing that the same proportion of materials are used, with the same item of expense for labor and incidentals, as follows. It having been ascertained that the ore from the mines whence you contemplate receiving your supply can be transported to your works at a cost not exceeding one dollar and a half per ton; we will estimate the cost of mining at 60 cents, which is believed to be ample, and allow 20 cents per ton for value in the mine; making the total cost of your hematite ore at the furnace, $2,35 per ton. Magnetic ore can be obtained in great abundance at $3 per ton, delivered at the works; Lackawana coal, upon an average, say $4,25 per ton, and lime 70 cents per ton; and the account will stand thus:

Say 2 tons coal		$8 50
" 2 do. hematite ore	$2 35	4 70
" ⅓ do. magnetic ore	3 00	1 00
" ¾ do. limestone	0 80	0 52
" Labor and incidentals		4 00

Making the cost of your iron $18,72 per ton on your wharf, and in as good a market as the city of New York. Thus you will have your iron at *15* cents per ton less than the Lehigh iron can be laid down at tide water for, and 78 cents per ton less than Scotch pig iron can be laid down in this country, even though we have free trade. And these, gentlemen, permit me to say, are no studied or forced figures, conjured up to present to you a pleasing and satisfactory evidence of the advantages of your enterprise, but are figures and statements that cannot be controverted or gainsayed; and this is not all; I need not stop here with the advantages you possess, but can assure you that when your iron is made, if made from the ores I have examined for you, you need not sell it in the same market and at the same price at which the Pennsylvania and Scotch irons must be sold, as it will hold altogether a different rank, and command a much higher price. As to the average price you will be able to obtain for it, I cannot give you any positive assurance, further than to

say, that the grade of iron with which yours will rank has never, for any length of time, run below $28 to $30, and often has commanded $35 to $40 per ton; but if we take the lowest point to which I have ever known it to go, say $24, it will still give you a very handsome return for your investment. Supposing your works to be of the capacity of the Hudson Iron Company's works, you will be enabled to produce from 12,000 to 14,000 tons of iron per annum—say the lowest amount and at the lowest price, and it will give you 15½ per cent. profit upon your whole capital, and in years of medium price, say $30 per ton, it would yield the very great profit of $134,400, or about 34 per cent. per annum.

These figures might, in some places, seem fabulous, and it is only because I can point to still greater ones, which have been realized in the iron trade, during the past two years, that I am emboldened to state what I so conscientiously believe to be within the bounds of prudence.

In addition to the direct profits upon the iron, there is one other, and quite an important one too, that you may count upon, and that is the increased value constantly added to your real estate, by means of the slag from your furnaces in filling up the bay about your works—and having so large a portion of your grounds on the east side of the Hudson River railroad, and running quite up to the Hudson and Boston railroad, where the filling is comparatively light, you will, in a few years, be able to offer to other and important manufacturing enterprises, the most desirable locations in the city of Hudson.

Estimate of the cost of erecting two Blast Furnaces of the size of the Hudson Iron Company's Furnaces, with two separate Engines, including Wharf, &c., &c.

Wharf, 300 feet front by 225 feet deep, with cribbed front and return crib on the south side, and piled side on the north—estimating the depth of the crib on the front to be eight feet, on the south side the average depth to be six feet; the piles on the north to be driven close together and sawed off at low water mark, and the wharf finished with square timbers same as in front, say five feet deep, the timbers averaging 12 inches square, all properly bound, spiked and anchored; the cribs to be 10 feet wide, with cross tie sections eight feet wide and twenty feet long, every twenty feet; will require about 21,000 feet running measure of timber for cribbing.

Wharf, 300 feet front by 225 feet deep, complete	$7,162 82
Two blast furnaces, of the dimensions of Hudson Iron Company's works, with two engines, blowing works, &c., &c., complete—including location	137,900 00
Working capital necessary to conduct the business in an independent manner	50,000 00
Thus making the cost of the works, complete	195,000 00
And leaving a reserved stock to be used for the purchase of mines, extending the works, or for such purpose as may be deemed for the interest of the company, of	$205,000 00

This, gentlemen, is a rough and brief estimate, yet it is made from data in my possession, and may be relied upon as not far from the actual figures you will find your works to cost. If there shall be found any difference in the result, it will be found that my estimates of the cost of wharf and furnaces are above the limit, as you may rest assured that the whole work can be put under contract with good and reliable parties at my estimates. I did not deem it necessary at this stage of your proceedings to go into a close and special estimate of each and every part of the works, as I believed it would not forward, but perhaps might, on the other hand, militate against the interest of the company, by preventing parties, when proposals are asked for the construction of the works, from bidding as freely and as independently as they otherwise might do.

IMPROVEMENT IN FURNACES.

The *Missouri Republican* (St. Louis) states that Dr. B. H. Washburn, of that city, has invented a method of feeding air to boilers on the tornado principle. It thus describes it:—

"Two connecting cones or funnels are inserted in the doors of the furnace, which insures a steady draft, and gives the air the form of the whirlwind. The ash pit is inclined at a good angle, reaching the bottom of the boiler from the door in the space of a few feet, and thus every particle of heat is saved and applied to the proper surface with the greatest intensity.

"But as all inventions or improvements are very correctly looked upon as possessing little merit without practical tests to recommend them, we will state for the satisfaction of the public, that this application has proved eminently successful, both with wood and coal, the trial having been thoroughly made at the Eagle Foundry. We have also had the funnels and inclined plane added to the steam apparatus of this office, and after a careful measurement of coal, find the saving to be at least twenty per cent. For further particulars we refer to the foundry mentioned."

Dr. Washburn resides at Hannibal, Mo., and has a patent on the connecting funnels; he has also taken measures to obtain a patent on his inclined ash pit.—*Scientific American.*

QUARRIES AND CLAYS.

AMERICAN MANTEL AND SLATE CO.

The slate quarry belonging to the American Mantel and Slate Company, is situated in the Township of Washington, Lehigh County, Pennsylvania.

It is within a very short distance of the Lehigh River, and the Lehigh Canal; and the depot of the *New Jersey Central Railroad* is to be located almost upon the line of the *quarry*. This road is graded, and the rails partly laid, and it will be in operation early in the coming fall, making a direct connection with the city of New York, two or three times daily.

The quarry is situated upon the northern slope of a bold hill, the foot of which is washed by the waters of *Trout Creek*, a tributary of the Lehigh River, along the whole line of the quarry tract—affording ample water-power for all quarrying purposes, as well as an abundant power for sawing, planing, dressing and working the slate in the manufactory.

This stream, flowing past the entire front line of the property, can be easily rendered available at any point, and is an invaluable acquisition.

The "benches," or compact strata of the slate are unusually large, being of sufficient size to allow of slabs of over *fifteen feet in length* to be worked out.

So perfect is the lamination, that in these large slabs but little surface dressing is required, and they can be obtained of any desired thickness.

The lines of separation, or, as they are technically termed, "joints," which pass between the "benches," are marked in this quarry with a clearness and distinctiveness which is but seldom found, and aid the working of the slate in a very material manner.

The plane of cleavage is also remarkably uniform, holding an unvarying dip of 45° through a "breast" of over eighty feet in altitude; while the "joints" carry an inclination of 20°.

Near the upper end of the quarry, on the face of the hill, the "breast"

shows the lines of joint and the planes of cleavage in a most beautiful manner, and prove at a single glance the high value of the quarry in relation to this degree of uniformity; nor is it merely an attractive view in regard to its intrinsic worth; it presents to the lover of natural science as clear a diagram of stratification arising from sedimentary deposition, with all the phenomena of unbroken curvature, and perfect lamination, as he can ever expect to find; in fact, it is to be doubted if the same degree of regularity has ever before been found in any one location.

The present "floor" of the quarry, or the stratum which has not been worked down into, can be taken up for about forty feet in depth, and will afford equally as good stone as any that has thus far been taken from the quarry; in fact, as a general rule, in quarries, so long as the stratification continues, the deeper the quarry is worked, the better the quality of the stone becomes; this arises from the fact that the stone which lies the deepest has for long ages been exempt from atmospheric changes and influences, and consequently retains its original qualities and character.

The largest "benches" are remarkably free from coarse grit, or silicious nodules, and hold a perfectly homogeneous composition—being compact, firm, and of uniform texture; and showing under the tool of the sculptor, or the drill of the moulding-machine, perfectly angular outlines of figure; taking, without fracture, the semblance of any device which may be worked upon it. For all inside work, or ornamental forms for outside purposes, this character is of essential advantage. For *Mantels*, *Tables*, &c., &c., the firmness of texture, and ease with which it is worked, render this material of peculiar adaptedness.

Its induration is of that permanent degree which constitutes a necessary qualification for roofing purposes, while the perfection of the plane, and the ease with which it is separated, add to its merits for this almost universal application of slate.

In addition to this favorable enumeration of its features, can be mentioned, that it is of that chemical purity which prevents those rapid decompositions which destroy the true value of many slates for economical purposes.

It is, while hard and compact enough to give, when struck, that peculiar ring or tone which denotes soundness and body, sufficiently soft to allow of the perforation of nail-holes without loss by fracture or deterioration by fissures or checks.

The quarry, as before remarked, fronts its whole length upon the margin of Trout Creek.

At the lower end of the tract, the bank rises about from *twenty* to *thirty* feet above the water level; this elevation gradually increases until at the upper line of the property the elevation reaches, by barometrical measurement, 149.5 English feet.

The line of front is about *two thousand* feet in extent. The outcrop of the slate is visible throughout the entire tract. The face of the strata is parallel with the stream, and their dip of 20° is into the hill. As the hill rises, "bench" after "bench" rises also.

From this cause the superincumbent mass of "deads," or "rubbles," is unusually light, precluding the necessity of any great amount of unproductive labor. Good "benches" of excellent slate can therefore be reached, even near the summit of the hill; and if the "deads" were removed, and placed upon the margin of the stream, so as to make a good road-way and permanent sites for manufacturing-buildings, and the breast of the quarry exposed over the whole line, there would be presented the enormous front of TWO THOUSAND feet, with an altitude rising gradually from *thirty* to *one hundred and fifty feet*; and with a deepening or working down of forty feet, the altitude of the whole extent would be from *seventy* feet to nearly TWO HUNDRED feet.

The strata all dip into the hill. There are a number of vertical seams which penetrate the mass into the hill to an extent which cannot be esti-

mated but by actual opening. These seams will allow of easy and expeditious openings of the quarry in sections back into the hill, nearly to the property line.

The slate extracted from these openings will more than pay for the expense attending them.

When one or more of these openings are completed, the quarry can be attacked in the rear, and upon the most facile line of cleavage, and the slate removed at a far less expense than is attendant upon its removal from the present "breast." By this arrangement the quarry can be attacked upon both sides, and ample room afforded for the labor of over *one thousand men*. It will require long and constant labor to place the quarry in this position; but when such point may be attained, this quarry cannot be surpassed by any other now operated upon.

One small part of the work is now uncovered, and the slate ready for removal, and in course of being taken away.

This block measures *one hundred feet* in length, by *eighty feet* in height, and *twenty-six feet* in width. Another "breast" has been formed, and which a separate gang of men are now attacking. But taking a glance at the line of the property, it scarcely seems as if it had been commenced upon. This comparison is instituted to show the value and extent of this tract.

A careful and expert workman can obtain from a cubic foot of slate, after allowing 33 1-3 per cent. loss by fracture and necessary wastage, at least *fifty* pieces of requisite surface and thickness for roofing slate.

This slate can be got out by contract at *two dollars* per square of *ten* cubic feet, and will sell readily and freely for four dollars per square. With about thirty hands, the quarry can send out *forty-five* squares daily at the lowest estimate, making a clear profit on this one branch of *ninety* dollars per day.

This is but one branch of the quarry work, and as wrought now, this branch will defray all the expenses attending the other branches of labor.

Another branch of the work arising from this quarry, is the manufacture of mantels and table-tops. By a beautiful process of enamelling the slate, it is made to partake of all the richness, depth, and softness of hue, of the best and most costly of the imported and native marbles; and so perfectly is the imitation produced, that a very close examination is required to distinguish between the original and the copy; even then the examiner must be a judge of the two articles, or he could not decide.

This enamel is not liable to break off or chip from the surface of the slate, by any change of temperature, as would be the case if the expansive property of the slate was like that of any metal, far in excess of the expansive property of the coating; both being equal, the expansion and contraction are alike on each, and no deterioration can possibly arise from this cause.

Any design can be produced that is desired in the style, veining and coloring of the enamel. The fancy of the most fastidious can therefore be gratified.

Marble is ever liable to stains from accidental causes; the casual overturning of an inkstand, or any other vessel containing a colored fluid or an acid, would result in the destruction of a valuable piece of workmanship. *Slate* prepared with this artificial marble, may be washed off with the strongest acids, and not suffer the slightest injury.

On the score of economy, these *mantels* and *table-tops* must greatly supersede the use of marble. Machinery has been brought to produce many of the mouldings and fanciful designs (which have hitherto been worked only by hand at a great cost), at a price so far below manual labor, that competition against this process is utterly ruinous and useless.

The finest mantels can be strictly imitated and delivered in a highly finished condition, at an expense *less* than that of the raw material of the hand-wrought foreign marbles.

It has been fully proved by a series of experiments instituted for the purpose, that the fine dust arising from the manufacture of the slate, is a valuable

substance when used as a non-combustible mineral paint. This can be prepared from the chips and dust, which have always been considered not only worthless, but an incumbrance which would gladly have been dispensed with. The low price at which this article can be afforded, combined with the quality which it possesses of rendering all articles painted with it *fire-proof*, must cause it to be extensively used in the painting of barns, factories, out-buildings and fences. A large revenue will necessarily accrue from this source to the company.

For minor articles of lighter fancy, suitable for ornamental purposes, the field is wide and unlimited. Vases imitative of the most costly material can be produced, vieing in elegance and finish with those elaborate productions of human genius, which are far beyond the reach of persons of moderate means, at a cost which will place them in the hands of the most humble. Statuary, seemingly of the finest Parian, ornaments apparently constructed of the rarest porphyries, and most costly verd-antiques, will grace the dwellings of the tasteful mechanic, and awaken thoughts of the beautiful in the home of the working man, which have thus far been confined to the residences of the opulent.

A *factory* for manufacturing the slate into mantels, &c., is erected upon the water-side, and is in successful operation. With its powerful overshot wheel, and the abundant water-power, it can turn out a large amount of work in the course of each month. It now holds *two* circular saw-mills for cutting the slabs into desired shapes, *one* planing mill for facing the slate, *one* grooving or moulding-cutting machine, an ample rubbing bed, and *one* upright saw-mill. Some idea may be formed of the importance of the machinery from the fact, that moulded mantels can be produced every fifteen minutes, that by hand-labor would require half a day to accomplish; while machinery must from its regularity of motion always produce a greater uniformity of work than can be executed by hand.

Arrangements are now being made to extend the size of the building, and also to build a railway from the quarry bed to the factory, by which the work will be greatly facilitated, and a large expense in labor saved to the company.

Possessing so many, and such unlimited resources, both in crude material and ability to produce manufactured articles, this property holds forth flattering inducements for the outlay of capital requisite for its full development. Once fairly under full operation, it cannot fail to afford a rich remuneration to the energy and money bestowed upon it.

S. P. Leeds.

MISCELLANIES.

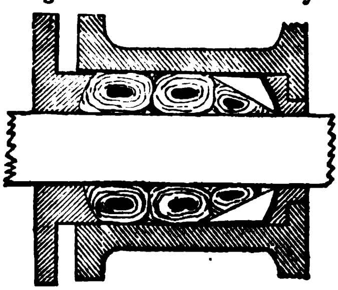
GEOLOGICAL SURVEY OF ALABAMA.

We learn from the Tuscaloosa Observer, that the geological corps of the State is completely organized, and at present engaged in working out the results obtained in the field the past summer and fall. Mr. Lieber has been employed in working out the somewhat complicated structure of Talladega county, particularly that portion of it known as the Hillabee. To Mr. Thornton, a graduate of the State University, and possessed of much practical knowledge, has been assigned the interesting part of the State occupied by the cretaceous rocks. To Dr. Mallett has been assigned the analysis of ores and other minerals brought to light by the survey. The soils, limestones, marls, green sand, and other agricultural resources of the State, will receive his special attention. Mr. Hallowell, an intelligent young gentleman, of North Alabama, is also attached to the corps. At an early day the party will be

dispersed over the State, each to his allotted field. The whole being under the direction of Prof. Tuomy, we look for the most valuable and satisfactory results. We have no information as to the time to be occupied by this important work, but when the geological survey is accomplished and laid before the public, our people, as well as law-makers, will, we predict, be well satisfied with the expenditure of the few thousand dollars it will cost. Accurately defined boundaries of the coal-beds alone, and other information connected therewith, would be worth more to the State than the cost of the entire geological survey.

TUCK'S PACKING AND METALLIC LININGS.

This Packing, of which the accompanying cut gives a general idea, is now being introduced in this country.



It is a prepared linen canvas, and used with the greatest success wherever soft packing is required. The experience of five years in England has proved it to be the first of its kind, both in regard to durability and economy. Being lighter than rubber(only weighing about two thirds to the same amount in bulk), it is cheaper in the first outlay. Its durability, in comparison with rubber, is about ten to one—that is, Tuck's packing will wear ten times as long as rubber or hemp; and then when rubber or hemp is taken out of the boxes it is thrown away, but this packing does not require to be taken out at all, when used in connection with the metallic linings, but is gradually and entirely worn away, thus saving time and material.

Engineers, and others who have used this packing, acknowledge its superiority over all other kinds known. There is a great saving of tallow, and a reduction of friction, consequently a saving of power. A better vacuum is maintained on long voyages than with any other material, thereby economizing fuel. It is made in lengths of ten feet, and from three eighths of an inch to two inches in diameter, and in sheets of any size and thickness.

It has been almost universally adopted in England, and is fast coming into general use in this country. For propeller shafts, pinions, &c., it is unsurpassable. It is manufactured in Brooklyn, and may be seen at No. 284 West-street, cor. Beach. Office of the Company, No. 81 Broadway.

VALUABLE LEAD MINES.

A subscriber, in Oliver's Prairie, Newton County, Missouri, writes us that a wonderful lead mine has been recently discovered in that township, by Mr. Foster, an English gentleman. The vein found is about four feet and a half thick, and of unknown extent. Mr. Foster has at present about fifty men engaged in working the mine, each one raising about half a ton of ore per day.

In addition, our correspondent states that the land, water and mineral resources of Newton County, are unrivalled. In fact, all that south-western Missouri needs is the south branch of the Pacific road to open her rich lands to purchase and settlement. The fact that mineral wealth is so abundant in that region, should serve to hasten the construction of the south-west Pacific railroad.—*St. Louis Republican.*

LEAD MINE IN TENNESSEE.

We are informed that in the vicinity of Riceville, Tenn., there is a very rich lead mine in process of working, where they are finding lead in great abundance. It is thought by the best mineralogists that it contains 25 per cent. of silver. We learn that the mine belongs, principally, to gentlemen living in Cass County, Georgia. We hope that they may find both lead and silver in great abundance, and we have no doubt but what they will from what we have learned of the prospects.—*North Georgia Times.*

GEOLOGY OF WEST TENNESSEE.

Prof. Safford has just completed quite a prolonged tour through this section of the State, prosecuting a geological survey of it. This survey, and others contemplated, will do much to bring before the public the vastness of our resources, Mr. Safford having, in the progress of his investigations, met with many mineral products of value. Among these are beautiful beds of marble in Henry, Benton, and Decatur Counties. This marble is closely like that from Rogersville, out of which the elegant columns of the Senate Chamber at Nashville were cut. It is of good quality, and well worthy of attention. Valuable beds of iron ore occur in both Benton and Decatur. In fact the great iron region, just beyond the Tennessee River in the Middle Division of the State crosses the river and covers a good part of the two counties mentioned. In Hardin, on both sides of the river, there is a beautiful bed of hydraulic limestone. It is really suprising that this limestone has not been noticed and more extensively worked.

In Henderson and Hardin, as well as McNairy, there are vast amounts of a stratified deposit, containing shells, etc., called "green sand," which is most valuable dressing for land, and must some day be an article of traffic. The Mobile and Ohio Railroad and no doubt the Memphis and Charleston road cut directly through it.

Among the many interesting geological features of West Tennessee, none are more so than the Mississippi "Bluffs." They have lately attracted additional attention on account of the supposed discovery of stone coal in some of them.

In Tennessee four of these "bluffs" are well known; the one at this point to which Memphis owes its appellation of "The Bluff City;" the next at "Old River," in the lower part of Tipton—now, however, nearly deserted by the Mississippi; the next at Randolph; and the remaining one at Fulton. At each of these points, the "bluffs" overlook the river for several miles, and, being from 100 to 200 feet high, are very conspicuous. At all the other points nothing can be seen from the river but the low banks of the great alluvial bottoms, the highest of them not much above high water mark. Hence the "Bluffs" have been for many years familiar land-marks to boatmen, and, commencing with the uppermost one, were formerly called by them the First, Second, Third, and Fourth Chickasaw Bluffs. If, however, we confine our attention to what can be seen from the river, we will form but a poor idea of their character. They are, in fact, but parts of a great uniform bluff which runs through the State from Mississippi into Kentucky; Prof. Safford has traced this remarkable cliff from Hickman to Memphis—it runs south, preserving nearly a straight course. It terminates abruptly at the Mississippi bottoms, and is the western limit of the high lands of the district. On the west end it is bold and precipitous, retaining all along its bluff-like character. The whole range was once unbroken—now it is cut, in our State, by about half a dozen small rivers which empty into the Mississippi. These cuts, however, are of but little importance in considering the general character of the great bluff. It is still

fresh. Every part of it has in time been washed by the river. It marks strikingly the eastern limit of those changes that the river has experienced in its literal movements from one side of its great alluvial plain to the other. The geological structure of the bluff is about the same at all points. It is made up of horizontal strata of earth, sand, gravel, clay, and lignite, which spread out eastward over the counties along the Mississippi. Beneath the soil and substrata we have:

1st. A great stratum of light yellow ashen earth or loam. To this bed is due the excellent soil we find in Obion, Dyer, Lauderdale, Tipton and Shelby. In the northern part of the State it is more conspicuous than it is southward. This rests upon—

2d. A heavy bed of gravel accompanied often by strata of sand and clay. At some points the gravel and sand are cemented so as to form a hard conglomerated or sand stone. Below this we have again—

3d. Layers of sand, interstratified with beds of brown coal or lignite and strata of clay.

The bluff at Memphis exposes the first and second divisions. The third which contains the lignite is below the bed of the river. In Lauderdale and Tipton the bluff is much higher and exposes near its base fine beds of lignite. This substance is far from being stone-coal, for which it has been mistaken. It is an imperfect coal, having too much the nature of wood to make it valuable. A fine bed of it is exposed at Raleigh, and Prof. S. is of the opinion it could be found at Memphis at a level below the bed of the river.

The formations of the bluff are of recent geological age. They were once continuous over a much wider area, and appear to have been deposited at a time when the relative level of the river and the land was very different from what it is now,—the river spreading out east and west lake-like and covering a vast breadth of country. Since that time the land has been elevated or the river depressed, and in consequence the water has excavated its present low valley out of those formations—remnants of which we now see in the bluffs. —*Memphis Eagle.*

LIGHTING MINES BY GAS.

The numerous fatal accidents in mines have given rise to many contrivances for preventing such evils. One of the most ingenious suggestions is from Mr. Septimus Piesse, who proposes to illuminate the mines by means of coal gas. The gas is to be made "on the bank," that is, on the surface, and carried down the shaft and along the "rolley ways," by fixed piping in the usual way, there to be kept constantly burning in properly constructed lamps, with an immovable gauze of wire round the flame. For supplying the lamp "in the galleries," where the actual workings are being carried on, the gas is to be conveyed by flexible tubing; by this means there will be no difficulty in moving the light to the position needed by the miner. Each lamp is to have a cone of fine Davy gauze wire round the flame, and to be protected by an outer casing of coarse gauze, which will prevent the transmission of flame to any outward explosive mixture in the pit.—*London Mining Jour.*